May, 1935

Railway Engineering & Maintenance

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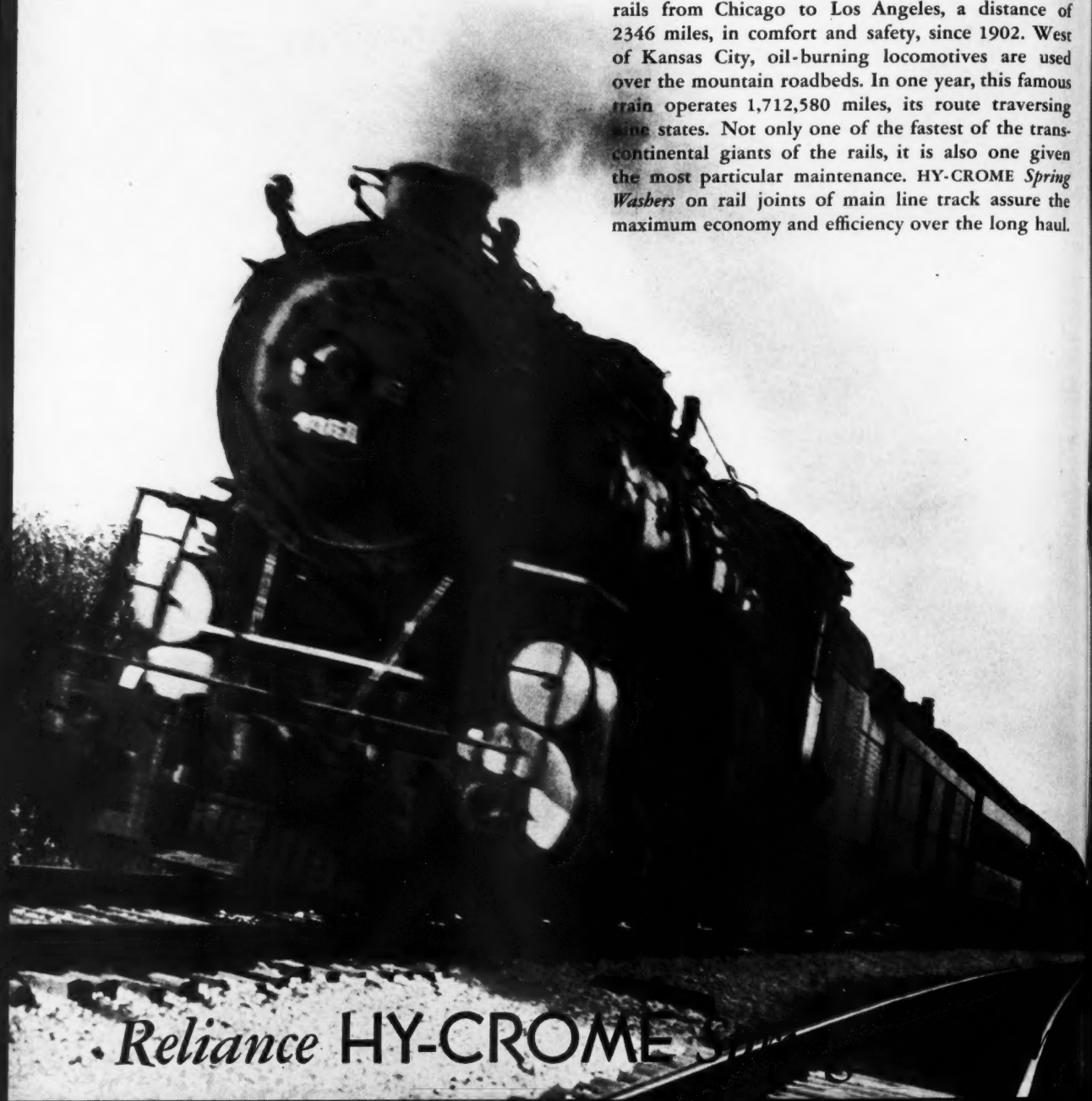

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Meets A. R. E. A. Spec.	*For screw spike use*	*For track bolts*	*For general use*	*For frogs—crossings*	*For special use*	*Used*

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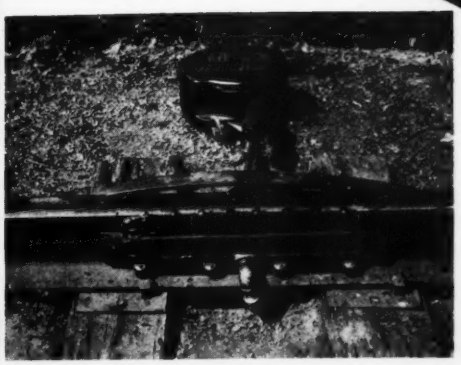

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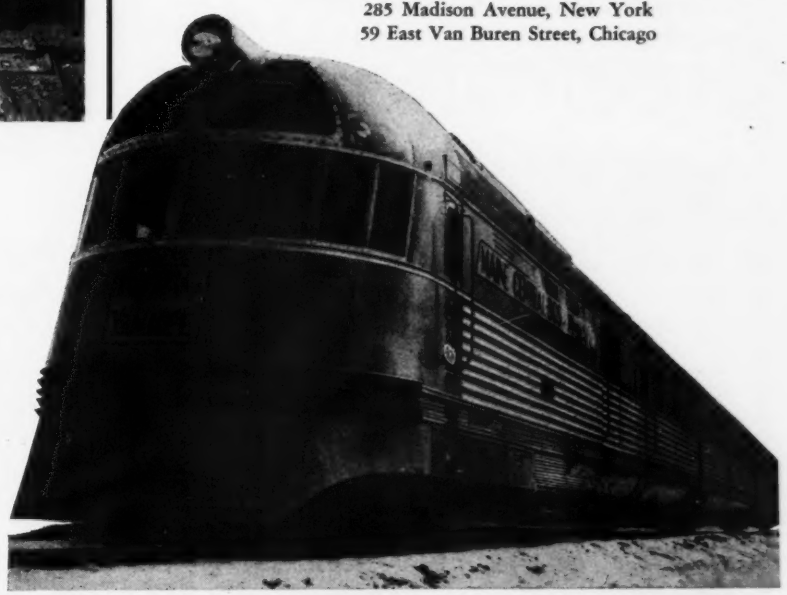

LUNDIE TIE PLATE

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MORRISON *for* ECONOMIES *in* MAINTENANCE !

MORRISON *Specializes* in Reinforcing & Repairing Steel and Iron BRIDGES

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THE DRIER THE TRACK THE LESS THE MAINTENANCE

Draining a stretch of wet track with Armco Perforated Pipe. Water pockets were tapped at various depths, at intervals from 25 to 50 feet. Note water flowing out of pipe.

"THE day will soon come," predicted a leading railway engineer, "when a wet track will not be tolerated under any circumstances."

Speaking from experience, he knew that the many miles of Armco Perforated Iron subdrains had definitely reduced maintenance costs to a minimum and had made high speed traffic a safe possibility on his lines.

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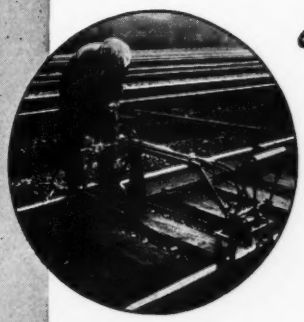
ARMCO PERFORATED PIPE INSURES BETTER TRACK

HIGH SPEED TRAIN OPERATION

Demands Smooth Track



● Rail with battered or chipped ends will not permit the operating economies inherent in the new light-weight, high-speed, streamlined trains. You can, however, have your rail in smooth-riding condition without requiring additional funds for track maintenance.

Building-up rail ends by oxy-acetylene welding with metal harder than the original rail has made thousands of miles of old rail ride like new. In almost every instance, the cost of welding has been more than offset by reduced cost of joint maintenance.

Oxweld Railroad Service also offers a low cost means of postponing batter on new rail which prolongs its smooth-riding quality. The new rail is given increased life through resistance to batter by the Oxweld process of hardening the ends. This special heat-treatment can be done under service shortly after the rail has been laid.

The Oxweld Railroad Service Company shows you how to accomplish these applications economically. Through this source, you can secure the latest information on any of the thousands of oxy-acetylene welding and cutting applications which are contributing greatly to railroad operating economies.

OXWELD RAILROAD SERVICE

THE OXWELD RAILROAD SERVICE COMPANY

Unit of Union Carbide and Carbon Corporation

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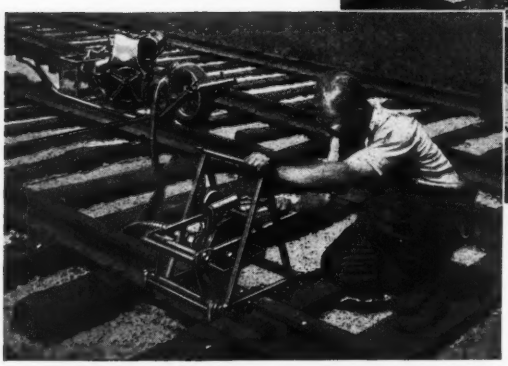
WITH THESE GRINDERS YOU CAN BE ASSURED OF BETTER RAIL JOINTS

This Surface Grinder has the most power with the least weight of any similar machine used for reconditioning rails by welding.



The Utility Grinder with its attachments is a general purpose tool for slotting, surfacing, switch maintenance and similar grinding jobs; also for boring holes for screw spikes and driving them in place.

Here Are the Other Tools in the Nordberg Line

Power Jack
Adzing Machine
Spike Puller
Track Wrench
Rail Drill
Track Shifter

These grinders are two of the line of eight tools developed by Nordberg for the maintenance of track and which have been adopted as standard equipment by many of the leading roads. They provide greater accuracy in grinding, do it faster and reduce the cost of reconditioning rails.

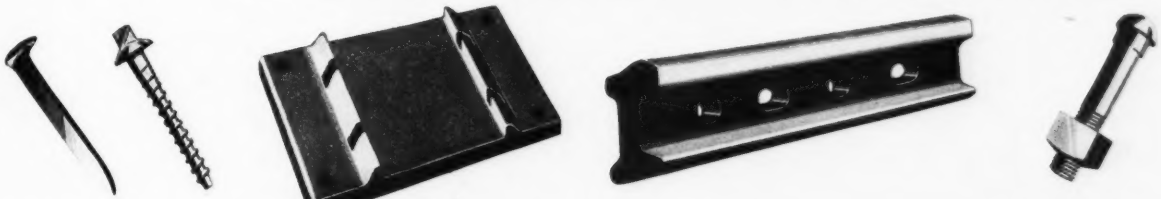
If you are considering a track program in which rail grinding is involved, investigate the merits of Nordberg Grinders, also these other tools that will assure of better track at less expense.

NORDBERG MFG. CO.
MILWAUKEE, WIS.

NORDBERG RAIL GRINDERS

SLEEP TIGHT, *Youngster*

● Modern railroading is taking the jounce out of travel. And Illinois Track Materials are doing their bit to help. Their quality is dependable. And they're ready to meet your demands—for any quantity, small or large.



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with 26 Joints to a Mile . . .

Economies made possible by continuous rail . . . rail welded into long lengths, unbroken by troublesome joints . . . are enormous. Suppose, for example, rails are Thermit Welded into 400 foot lengths. There are then only 26 joints, instead of the usual 260, per mile of single track. Ninety per cent of present joint maintenance is banished immediately. What's more, the need for track lining and surfacing becomes less frequent. Rail life is lengthened; wear and tear on equipment reduced.

European and Australian railroads have been Thermit Welding rails in main line track since 1927. In America, long welded rails have been giving satisfactory service for the past year and a half. No trouble from expansion or contraction has ever developed.

Thermit Rail Welds can be installed by your own track forces at a cost comparable with ordinary rail joints. And, since Thermit Welding forms rails into continuous stretches of homogeneous steel, with no gaps or rough spots for wheels to pound, the first cost is the last cost. Write for the complete story.

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No. 77 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Our Oldest Reader

April 25, 1935

Dear Reader:

In the last issue, I told you of the replies to my letter in the August, 1934, issue, in which I enlisted your co-operation in a search for our oldest reader. I believe I have found him. He is William Woolsey, a section foreman on the Illinois Central at Ridott, Ill. I will let him tell his own story.

> "I subscribed for the old Roadmaster and Foreman back in 1902," he writes, "when I was working as a track laborer on the Rock Island at Des Moines, Iowa. A short time later I transferred to another department and allowed my subscription to lapse.
>
> "In the fall of 1904, I returned to track work and again subscribed for the magazine. Since that time I have never missed an issue, continuing with the magazine through its various changes until it was incorporated in Railway Engineering and Maintenance in 1916.
>
> "I would not think of trying to maintain a section," Mr. Woolsey adds, "without your magazine."

We are proud that so many of you have maintained your interest in Railway Engineering and Maintenance for so many years. We are proud especially of Mr. Woolsey's long-continued interest. This is a record of which few publications can boast, for 31 years is a long time for any one to subscribe to a single magazine.

Such loyalty as this places on us a responsibility for continued service to you that we do not hold lightly.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor

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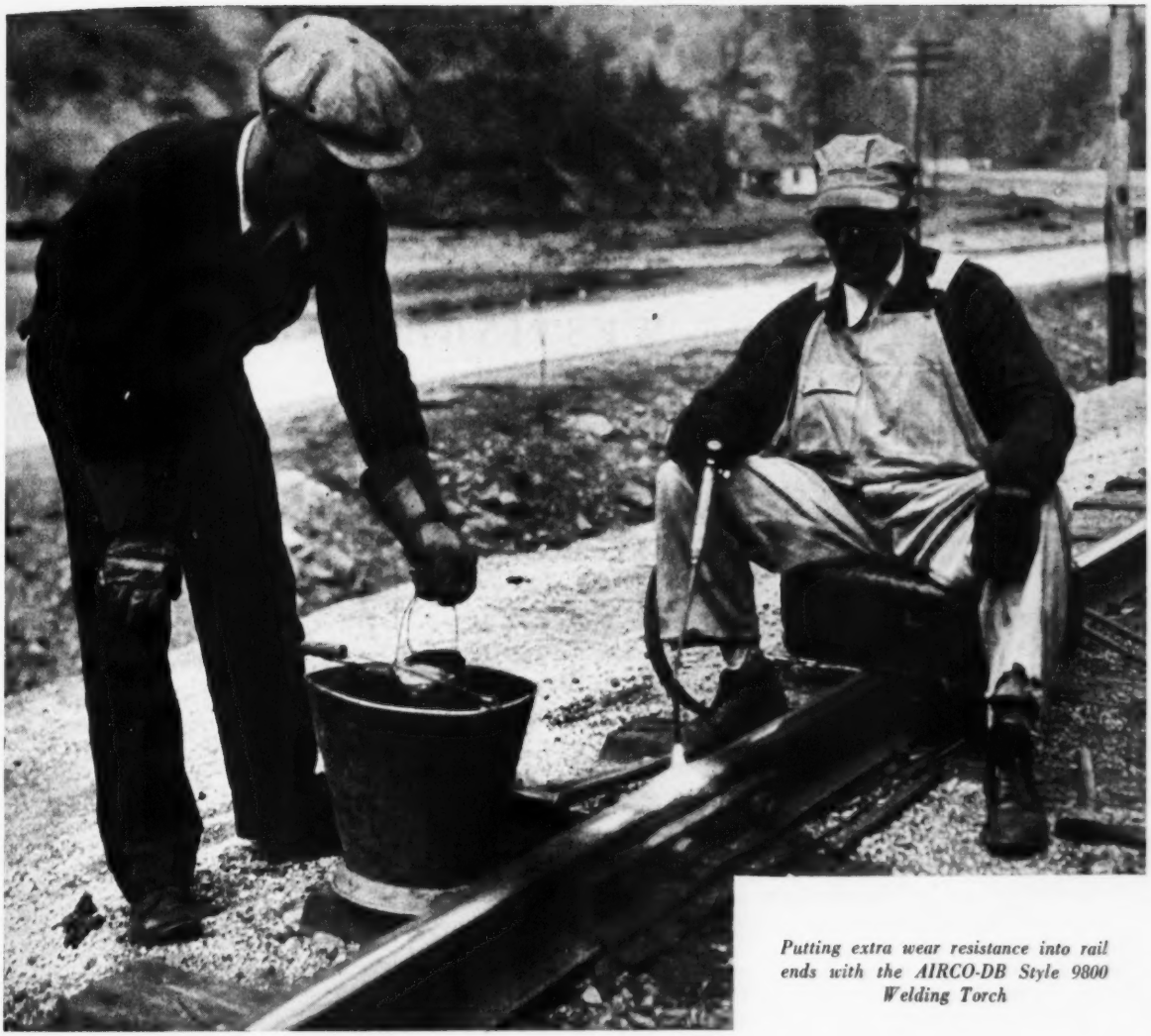

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It's the RAIL ENDS that get the worst beating. Their resistance to wear determines rail life. The process of HEAT TREATING practically eliminates the expense of building up, postpones replacement, and substantially reduces maintenance costs.

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TO STEAM RAILROADS

★With this announcement, the vast manufacturing and technical facilities of Westinghouse, and the Hollup Corporation Sales Service combine to bring United States and Canadian railroads a new high standard of efficient welding service.

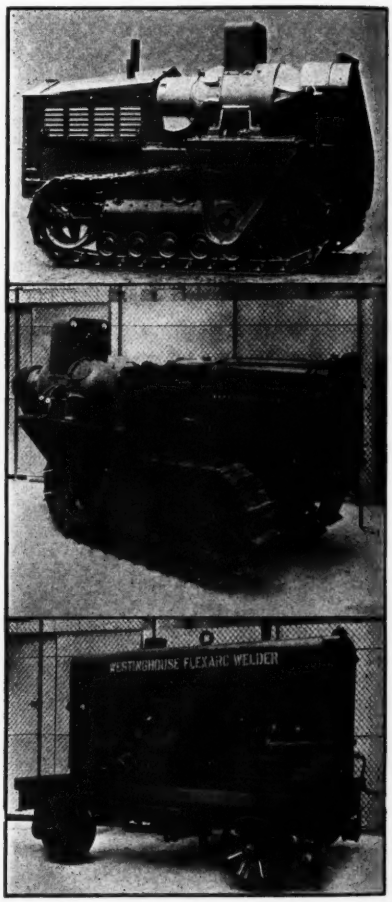
Westinghouse pioneered the development and application of arc welding. For years the outstanding excellence of Westinghouse FlexArc welding machines has been recognized throughout every division of industry. FlexArc machines . . . a-c. and d-c., manual and automatic . . . are available for every steam railroad application.

Westinghouse Welding Equipment, with or without auxiliary power for operation of track working-tools, is available to meet the various service requirements of track, bridge and building repair and construction.

The Hollup Corporation, for 21 years, has led in developing the highest-grade of welding materials and in the solution of arc welding problems. Today, the Hollup national system of welding distribution and service to railroads is unequalled.

This new Westinghouse-Hollup relationship establishes the largest and best-equipped source of welding equipment and technical assistance for railroads. Westinghouse invites you to use the Hollup service.

Hollup Corporation will serve you from 3357 W. 47th Place, Chicago, Illinois.



(Upper) Westinghouse Welding Equipment mounted on a Cletrac Tractor. Courtesy of the Cleveland Tractor Company.

(Center) Westinghouse Welding Equipment mounted on McCormick-Deering Tractor.

(Lower) Westinghouse Welding Equipment for Trailer service, equipped with hydraulic power take-off. The handle is dismounted when not in use.

**Except Back Bay Area of San Francisco.*

Westinghouse R 52036-A

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Circulation Statement

"This is to certify that the average circulation per issue of RAILWAY ENGINEERING AND MAINTENANCE for the six months period July 1 to and including December 31, 1934, was as follows: Copies sold 6,412; copies distributed free 519; total 6,931.

H. E. MCCANDLESS,
Circulation Manager,
Simmons-Boardman Publishing Company.
Subscribed to and sworn before me on this 12th day of April, 1935.

HENRY D. NELSON,
Notary Public, Queens County, N.Y."

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

May, 1935

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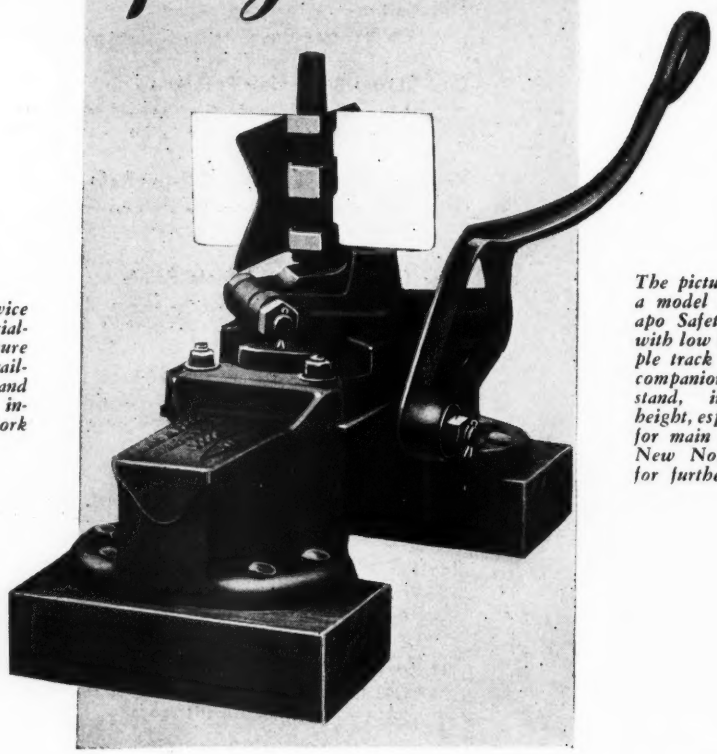
RAMAPO SAFETY SWITCH STANDS

speed up Yard Traffic

Behind Racor Service stand nine plants specializing in the manufacture and distribution of railroad track turnout and crossing equipment, including Manganese Work for heavy traffic.



The picture at the left is a model No. 20-B Ramapo Safety Switch Stand with low target for multiple track locations. The companion safety switch stand, in intermediate height, especially designed for main line use, is the New No. 17-B. Write for further information.

NRA CODE
RAILROAD SPECIAL TRACK EQUIPMENT MANUFACTURING

IN THE rapid handling of cars during switching operations there is the ever-present chance of shunting cars through closed switches with resultant damage to switch points and rigid switch stands. Regardless of the known hazards of such miscalculations, and in spite of the discipline with which switching crews are imbued, mishaps of this kind are frequent. Invariably, with rigid switch stands, they result in delay and expense. This constant threat of trouble makes men over-cautious and slows up their work.

Ramapo Safety Switch Stands completely eliminate all the penalties of trailing through closed switches. When this occurs, a spring mechanism allows the points to move over under pressure of the wheel flanges and properly carry the car on its way. No damage is done to the points or to the switch stand. The target follows the points and indicates their true position, whether thrown automatically or by hand.

RACOR TRADE MARK

So successfully have these simple devices done their appointed task that more than 300,000 of them are in use on 300 railroads.

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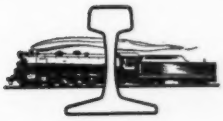
Railway Engineering and Maintenance



The Railways

Are They Alive to Present Conditions?

ARE the railways alive to the needs and opportunities of the day? Or are they being outdistanced by younger and more active competitors? These questions are being raised with sufficient frequency by intelligent, well-meaning persons to warrant consideration by every employee of the roads. They reflect the fear either that the onward march of civilization is relegating the railways to the category of the stage coach and the canal boat, or that railway management is so inert as to be more or less hopeless. Whatever the condition that is implied, it represents a point of view that cannot safely be ignored. Is it warranted? Let us look at the facts.

Some Measures of Decline

We face first of all the fact that whereas 30 years ago the railways of the United States were building as much as 6,000 miles of new lines in a single year, they built only about 625 miles per year in the more recent boom period of 1927-29, and construction has practically ceased since that time. Even more striking is the fact that 50 per cent more miles of lines have been abandoned and taken up than have been built since 1917.

In traffic a similar change is evident. Passenger traffic, for illustration, declined steadily from 1920 until last year, with the result that it is now only 35 per cent of the 1920 volume. Likewise, in freight traffic the peak occurred in 1926, although in 1929 the volume was only slightly lower. It is significant that the high points in the volume of both passenger and freight traffic occurred well prior to the crash of 1929, so that the declines cannot be attributed solely to the depression, but must be traced to other causes. What are these causes?

From the earliest days of the railways, they have rendered a more or less monopolistic service. For the very large part of its traffic, no other agency was able to compete. Of late, however, the construction of our vast system of highways has brought in its wake the bus and the truck, with cheaper and frequently more convenient service. Likewise, the development of aviation has made possible a faster service between major centers than the railways have provided, while the expenditure of vast sums of public money for the canalization of our inland streams has diverted an appreciable volume of low grade freight to the barges. These newer agencies, liberally subsidized by the public in one form or another, have presented a competition which the railways have found it difficult to combat. Recent developments demonstrate, however, that they are now alive to the situation and are determined to meet it.

Most spectacular of the measures that are being initiated to meet the new conditions are the markedly faster schedules that are being introduced by trains of Diesel, electric and steam propulsion. The first of the "superspeed" trains to be built were those for the Union Pacific and the Burlington, both embodying departures from conventional designs. Indicative of their possibilities is the 1,015-mile, non-stop run made last May by the Burlington's Zephyr from Denver, Colo., to Chicago in 13 hr. 5 min., at an average sustained speed for the entire distance of 77.5 miles per hour, a reduction of 5 hr. 48 min., or 30 per cent from the previous record between these points, which had stood since 1897, and comparing with a presenting schedule of 26 hr. 15 min.

No less noteworthy was the run made by a Union Pacific Diesel-powered six-car train from Los Angeles, Cal., to New York last October, which traversed the 2,298 miles to Chicago at an average speed of 59.2 miles per hour, while the 508 miles between Cheyenne, Wyo., and Omaha, Neb., was covered at the rate of 85 miles per hour. This record of 38 hr. 47 min. from Los Angeles to Chicago compares with the best previous record of 44 hr. 55 min. made by "Death Valley Scotty" in 1905.

Nor was steam to be outdone, for on July 20, the Chicago, Milwaukee, St. Paul & Pacific operated a train in regular service from Chicago to Milwaukee, Wis., a distance of 85 miles, in 67 min. 35 sec., with an average speed from start to stop of 75.5 miles per hour and a maximum speed of 103 miles per hour for 5 miles. Still another record was broken on the Atlantic seaboard within recent weeks, when the Pennsylvania handled President Roosevelt's special train over its newly-electrified line between Washington and New York, a distance of 226 miles, in 173 min., an average speed of 78 miles per hour for the entire distance.

Schedules Are Shortened

These isolated runs have been the forerunners of greatly shortened schedules. Effective January 2, the Chicago & North Western placed its steam-propelled "400" train in service between Chicago and the Twin Cities on a schedule of 420 min. for the 408 miles, which schedule was reduced to 390 min. on April 28. Likewise, the Burlington placed its Twin Zephyrs in service between the same points on April 21, on a schedule of 390

min. for the 431 miles, while the Milwaukee will place in service between the same points late this month the first streamlined steam locomotive and train to be built especially for high-speed service, which train will traverse the 410 miles in 390 min.

Similarly, the Union Pacific has announced that it will soon place new Diesel-powered, streamlined trains in service between Chicago and the Pacific Coast on schedules of less than 40 hr., as compared with minimum existing schedules of 54 to 59 hr. Likewise, the Pennsylvania is gradually reducing the schedules of its electrified trains between New York and Washington to less than 4 hr. The new streamlined "Flying Yankee" of the Boston & Maine has reduced the running time between Boston, Mass., and Portland, Me., approximately 2 hr., while the Baltimore & Ohio, the New Haven and other roads have trains under construction which are designed to reduce the running time on important routes. In a similar manner, the schedules of existing trains are steadily being reduced, typical of which is the shortening of the running time of the "Century" and the "Broadway" between New York and Chicago to 17 hr., effective April 28, as compared with 20 hr. only three years ago.

Travel Comfort

Nor are the railways confining their improvements in service to reductions in schedules, for revolutionary contributions are also being made to travel comfort. The most important contribution of this character is the air-conditioning of passenger equipment. First undertaken experimentally less than five years ago, it has been pushed so rapidly that 6,000 air-conditioned cars will be available for this year's summer travel, sufficient to equip practically all of the through trains in the country. For this single modernization measure, the railways are spending approximately $36,000,000, largely within two years.

Hand in hand with air-conditioning is the redesign of day coach equipment to introduce more comfort through modern seating, better illumination and improved conveniences in other respects. This movement, which is already in evidence in hundreds of coaches, is gaining momentum rapidly.

Another measure which the railways in the West and South have adopted to attract traffic back to the railways has been the reduction of fares from 3.6 cents per mile, established during the war, to 1.8 cents and 2 cents on the Western lines and 1.5 cents on the Southern lines.

Also in Freight Service

Nor is the revolution in transportation methods confined to passenger service. It is equally pronounced, although less spectacular, in freight service. It is characterized by schedules so shortened as to demand speeds approaching those of passenger trains, with overnight deliveries to points as remote as 300 miles. Some roads are handling l.c.l. freight on local passenger trains to expedite its delivery.

Most outstanding among the innovations in freight service has been the introduction of pick-up and delivery service, through which the railways are giving the shipper all the convenience of highway truck service by sending their own trucks to convey his shipments from his warehouse or factory to the railway and the reverse. This service is being expanded rapidly, some roads now offering it to farmers and other shippers of livestock.

Evidence of Progressiveness

These measures are indicative of a wide variety of innovations which the railways are making in their freight and passenger services to meet the needs of their patrons. They offer eloquent evidence of the fact that railway managements are alert to the needs of the day and are setting about to meet them.

Nor is the public unappreciative of this service, for in 1934, for the first time since 1920, the railways showed an increase in passenger traffic as compared with the year preceding. Likewise, those roads which have introduced new trains are carrying capacity loads, and an appreciable part of the passengers come from other agencies of transportation. In a similar manner, the railways that are offering pick-up and delivery service for freight and other aids for shippers are finding that traffic is returning to them in increasing volume. For illustration, one railway which pioneered in the introduction of store-door pick-up and delivery service for freight in December, 1933, now finds that more than 60,000 shippers are using its service.

The railways have long been the nation's principal transportation agency. The aggressive manner in which they are now meeting changing conditions, even when hampered by inadequate earnings, is a tribute to their leadership and resourcefulness. Rather than displaying lack of initiative, the railways are setting a pace for other industries, to which every employee can point with pride and can emphasize in conversations with those with whom he comes in contact.

Tests

There Is Still Much to Be Learned

THE building up of battered rail ends by welding has been carried on for so many years that the economic value of this practice is now thoroughly established. More recently, experience with the heat treatment of rail ends is resulting in the accumulation of data that point to its early acceptance as another means of rail conservation worthy of general adoption. For this reason, the information presented in the article by C. H. R. Howe on page 289 of this issue should be of interest to every railway officer who is concerned with the service life of rail. Special attention should be given the chart showing the progressive rate of batter observed in rail subjected to various means of increasing resistance to the destructive effect of the passing wheels.

In this connection emphasis should be placed on the fact that the data shown were obtained with a type of batter gage capable of much greater accuracy than is possible with the ordinary taper gage and a straight edge. This does not imply any criticism of the straight edge and taper gage for routine use in determining whether the batter is sufficient to require corrective measures.

Rather, it calls attention to the need for greater refinement in measurements taken in the course of tests to determine comparative results, as in the case described in the above-mentioned article.

The article has its primary value, however, in pointing to the opportunity for the development of reliable data by means of carefully conducted tests. While the results obtained in the tests made on the Chesapeake & Ohio confirm the conclusions of others as to the economic value of rail-end heat treatment and beveling, it is possible that some maintenance officers will take exception to some of the details of the results. Such differences of opinion point to the desirability of further tests on other railroads, possibly under different volumes of traffic and standards of maintenance.

Passing Sidings

To What Standard Should They Be Maintained?

IN THE past, local maintenance forces have frequently been inclined to look upon a passing siding as just another track to be maintained. They have known, of course, that it had to be kept in condition for service. For this reason, when necessity demanded, it was given a general overhauling, but little further attention until it needed another overhauling. Larger locomotives and cars, longer trains, higher speeds and new operating methods have combined to make the passing siding more important track in late years. Yet, it is an unfortunate fact that, too often, the older method of maintenance is still being followed.

In general, the importance of a passing siding depends on the frequency of its use and the speeds of trains passing through it, although the latter may be the deciding factor in fixing the standard of maintenance, particularly if it is used by passenger trains. In recent years, many passing sidings have been equipped with long turnouts and remotely-controlled switches, permitting trains to be operated through them at relatively high speeds. By lapping the turnouts, they are sometimes used to run a fast train around a slow one or, on single track, to arrange for meets without stopping either train.

Such use requires a higher standard of maintenance than was usually considered necessary a few years ago. All passing siding should have ample ballast of good quality, preferably of the finer kinds such as gravel, chatts, etc. A good quality of "released" rail should be applied, and on busy districts this should be 100 lb., or heavier. While it is not necessary that the ties be of the same size as those in the main tracks, they should be of equal quality.

Line and surface should be maintained substantially to main-line standards, particularly where trains are operated at relatively high speeds, and gage should always be standard. On lines of lighter traffic and on sidings that are used infrequently and at lower speeds, these requirements can be relaxed somewhat, but the factors which affect safety, such as gage, condition of ties, line, surface and joints, should receive the same attention as on those tracks that are used more intensively.

Good drainage is no less essential for a passing siding than for a main track. In fact, if the drainage of the siding is defective, it may be expected that that of the main track will become equally defective in a short time. Sidings should be kept clear of weeds and rubbish, for neglected policing will soon mar the appearance of the main line, even though the latter may be given more careful attention than the sidings.

Grade Separation

Why the Maintenance Man Is Interested

THE allotment of federal funds previously appropriated by Congress and the earmarking of a large sum from the vast unemployment relief fund recently placed at the President's disposal give assurance that grade separation will occupy a large part of the time of the designing and construction staffs of the railroads. However, in spite of the fact that the maintenance organizations have no direct part in these activities, they have a vital interest in what is done because they are responsible for the upkeep of the structures after they have been completed and placed in service.

Progress in the improvement of designs for grade separation structures since the advent of the general movement for the elimination of grade crossings some 40 years ago, has been influenced to a large extent by experience in the maintenance of the earlier bridges. This has been evidenced by measures for better drainage, greater refinement in waterproofing, details that will mitigate corrosion and facilitate repairs, etc. In fact, records of experience in the maintenance of structures previously built not only serve as the basis for improvements in design, but also provide the supporting data in negotiations incident to the approval of these designs by public authorities.

The maintenance officer also has a direct interest in the construction of the grade separations because of his responsibility for safety of traffic, and with the changes in construction procedure that have been introduced as a result of conditions imposed in the granting of federal funds for this work, these responsibilities have been increased. Obviously, every wide-awake member of the maintenance of way department has a keen interest in the program for widespread grade separation fostered by the federal government, and is anxious to know of the extent to which his road and his territory in particular will benefit from it. But further than this, he is vitally concerned as to the manner in which the work is done.

RAILWAY INCOME IN JANUARY—Class I railroads in January had a net deficit after fixed charges, depreciation and retirements of $21,990,622, as compared with $11,585,335 in January, 1934, according to the Interstate Commerce Commission's compilation of selected income and balance-sheet items. Before depreciation and retirements the net deficit was $5,862,581. Total current assets at the end of the month amounted to $1,021,295,795, while the total current liabilities were $1,421,395,692, including $310,608,852 of matured interest unpaid and $276,804,723 of matured funded debt unpaid.

Dust Storms Bring New

for Maintenance Men

For more than two months dust storms of unprecedented severity have raged over a large area in the west, creating new problems for railroad maintenance forces. This article, which is based on information obtained from men on the "firing line," gives a first-hand picture of what these dust storms mean to maintenance men.

Above—View of an Approaching Dust Storm. Below—This Scene Is Typical of the Hundreds of Miles of Sand Drifts that Have Accumulated Along Right-of-Way Fences

TRACKMEN patrolling tracks in a choking atmosphere of dust, ahead of trains that creep along at a snail's pace in almost total blackness; cuts filling with sand and dust almost as rapidly as they are cleaned out; mile after mile of right-of-way fence buried permanently under huge drifts; blocked switches, dust-filled culverts and side-ditches, and fouled ballast—all these form a part of the immediate picture that is left in the wake of the dust storms that have swept over a large area of the western plains during the last two months and that are still prevailing in portions of this area as we go to press. The ironical aspect of the situation lies in the fact that, while heavy general rains afford the only permanent means of relief from these dust storms, such rains, when they do come, will add to the problems of the maintenance forces by reason of the blocking of ditches and culverts.

The region afflicted embraces portions of six states, including nearly the entire western half of Kansas, the eastern third of Colorado, a relatively small area in southwestern Nebraska, the Oklahoma and Texas Panhandles, and a relatively small area in northeastern New Mexico. This comprises the area where the storms have been most severe although a much larger territory has been affected in lesser degree. Here sub-normal precipitation for three years has resulted in the top soil being so thoroughly dried out that it blows about freely. While recent heavy rains have served to alleviate the dust conditions in some parts of the area, other portions have obtained little or no relief.

The territory in which the dust storms have been most severe is traversed, largely in an east and west direction, by five large systems, including the Atchison, Topeka & Santa Fe; the Chicago, Burlington & Quincy; the Chicago, Rock Island & Pacific; the Missouri Pacific and the Union Pacific. These lines have all been affected in varying degrees by the storms.

Dust storms have raged in some parts of the area almost daily since late in February. One railroad reports such storms during 30 of the last 45 days. Some are local in character, while others are more general in scope. They travel as rapidly as 55 miles an hour and in some cases the visibility is almost zero.

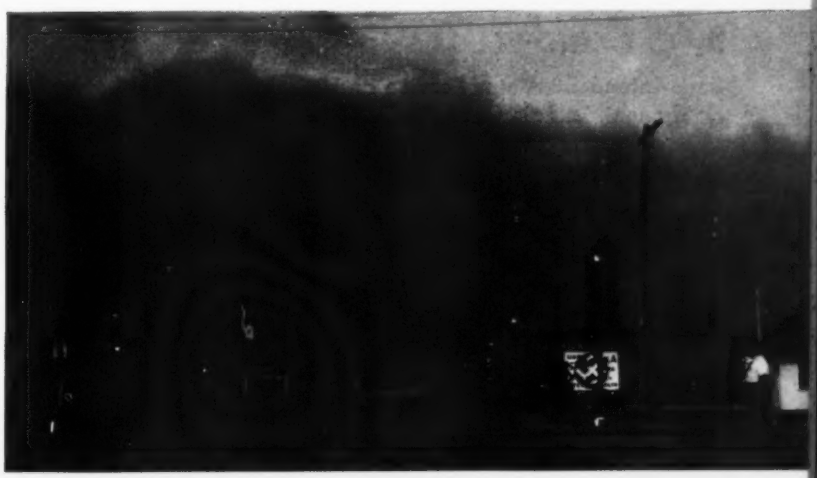
The most immediate effect of the dust storms, from the maintenance standpoint, is the drifting of sand across the tracks in cuts and elsewhere, especially at cattle guards and wing fences, where the velocity of the wind is reduced by the obstructions, causing the particles of dust to be deposited. In some instances the deposits in the vicinity of cattle guards have been so heavy as to necessitate the removal of these guards. One of the most potent causes of trouble is the drifting of dust around switches, frogs and guard rails; during the more severe storms the switches become choked with dust almost as rapidly as they can be cleaned and it is necessary to give them almost constant attention.

Various measures have been adopted to retard the drifting of the dust over the rails. Several roads have installed snow fences or similar wind-breaks at strategic points. At the more troublesome points one railroad has constructed what a superintendent describes as "old-fashioned rail fences" built of old ties, while at other points it has laced brush into the right-of-way fences to form a barrier and prevent the drifting of dust on the tracks.

On the other hand, the piling up of

Problems

Ditcher Outfit Removing Sand Drift Near Siebert, Colo.



View of a Typical Dust Storm

thistles and tumble weeds against the fences has formed natural windbreaks, which, while temporarily effective in preventing drifting on the tracks, soon become entirely covered, thereby losing their effectiveness and resulting in considerable loss to the company. As a result, one superintendent in the storm area has come to the conclusion that the use of sand fences to prevent drifting affords such temporary relief that the best solution is to afford a "clean sweep across the right-of-way." In describing his difficulties this officer writes that "it is a trying time as the wind blows in different directions, causing a cut that is cleaned out one day to be filled the next."

The filling of ditches and culverts with dust and the fouling of the ballast has presented a unique and perplexing problem. Generally speaking, maintenance forces have been so fully occupied with the more pressing problem of keeping traffic moving that little time has been available for cleaning ditches and culverts. For this reason there is much concern as to what will occur if the much-needed rains materialize before the waterways can be opened. "Drainage ditches," writes one division engineer, "are entirely filled and there is no telling what will happen if we should have a sudden downpour before they can be cleaned out."

The problem of fouled ballast, of course, is a major one throughout the drouth area. On hundreds of miles of tracks the interstices in all kinds of ballast have become completely filled with minute particles of sand and dust. While this condition will have little effect on maintenance pending heavy rains, it is distinctly undesirable because of the large clouds of dust raised by passing trains, with resulting damage to equipment and discomfort to passengers. Furthermore, when the rains come, the dusty condition of the ballast will, as one trainmaster states, "result in a great deal of puddled track."

Not the least injurious aspect of the dust storms is the demoralizing effect which they have had on maintenance work schedules. During the more severe storms it is necessary for track forces to devote practically their entire time to efforts to keep the tracks open for traffic. This includes patrol and flag duty in advance of trains and at switches and other dangerous locations, and the riding of trains so that men will be on hand if drifts are encountered. One division engineer advises that during the more severe storms it is necessary for the section forces to devote 90 per cent of their time to efforts to keep trains moving. The situation has naturally resulted in considerable overtime among track forces, while in some cases it has been necessary to hire extra labor to assist in removing dust from the tracks.

In addition to these more severe aspects of the dust storms, they have served to increase the difficulties and expenses of maintenance in numerous other ways. Bad dust storms, advises one division engineer, "are extremely hard on motor cars, incurring wear and additional expense for the maintenance of cars and parts." Another remarked that if a motor car is exposed for as much as 24 hr. during a bad dust storm it is likely to be so badly damaged as to be useless until new parts can be obtained. As with motor cars, the moving parts of equipment in pumping plants and coaling stations have also been damaged in some instances.

The following quotations have been selected at random from communications from railway officers.

"We have 22 cuts, totaling five miles in length, which were completely filled with sand and dirt. . . ."

"We have had a number of cases where trackmen had to abandon their motor cars and walk into town, the visibility in some instances being so poor that they had to find their way by following the right-of-way fence.

"The cut ditches in 250 miles of lines are practically all filled, although with the extensive use of slat fencing we were able to keep the sand from covering the rail in practically all cases."

"Dust has interfered in numerous ways with the normal operation of signal apparatus and has been responsible in many cases for poor signal lights."

"Nothing escapes the penetrating power of the dust. For instance, we have found switch locks so full of dust that it is necessary to clean them out before they can be used."

Keeping Work Equipment Off the Rails*

By C. R. KNOWLES

Superintendent Water Service and Work Equipment, Illinois Central, Chicago

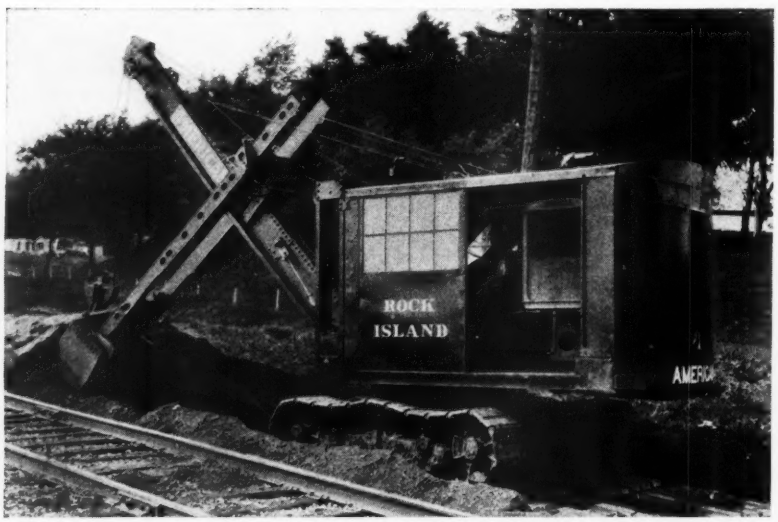
While considerable progress has been made during the last several years in the development of off-track equipment for conducting maintenance operations, the opportunities in this direction have by no means been exhausted. In this article Mr. Knowles reviews the whole question of off-track work equipment and points out the possibilities and limitations of the various types.

RAILWAY tracks are designed primarily for the transportation of passengers and freight. All other operations that necessitate the use of main-line tracks are secondary to the movement of trains and must be conducted in such a manner as to cause no interference with regular traffic. Thus one of the principal handicaps to the continuous operation of work equipment mounted on the rails is the necessity for keeping the track clear for the passage of trains.

In the development of mobile units of maintenance of way work equipment it was quite natural that they should be mounted on flanged wheels for operation on the track, and for many years this was the universal practice. The present trend, however, is toward off-track equipment. More and more railroads are using motor trucks, and crawler and other types of tractors in the performance of many maintenance jobs, thus cutting costs by avoiding delays that would be occasioned to track-mounted equipment by the passage of trains.

Many manufacturers of work equipment have directed their efforts toward reducing the weight of track-mounted machines and improving derailing devices designed to facilitate their removal from the track with a minimum of delay to their operation. However, the loss of a certain amount of time with such machines is unavoidable as their movement to and from the point of work must be timed so as not to interfere with train operation. In order, therefore, to secure the maximum efficiency from certain classes of work equipment it is necessary that they be operated independently of the track—in other words they must take the form of "off-track" equipment.

*Abstract of an address presented before the Maintenance of Way Club of Chicago.



Crawler-Mounted Dirt-Handling Machines Are Widely Used by the Railroads

Strictly speaking, the term "off-track" equipment embraces all machines not mounted on flanged wheels, including portable tools and power plants mounted on skids and designed to be transported on push or trailer cars. As used in this discussion, however, the term applies only to self-contained units mounted in such a manner that they are capable of moving under their own power.

Classification

Off-track equipment designed for service in maintenance-of-way work may be classified under two general heads: (1) Rubber-tired vehicles; and (2) crawler-mounted equipment. A further division may be made as between (1) equipment used for transportation only, and (2) that used both as a transportation agency and as a source of power. The first group in each case includes motor trucks and automobiles, which are used largely as a means of transporting men and materials. While it is true that certain types of equipment

are mounted on motor trucks, such equipment is usually supplied with its own power plant, and, although the engines of motor trucks are sometimes adapted to use as power units for the operation of equipment, a special design of power take-off is required that is not available on standard trucks.

Included in the second group in the latter classification are tractors of both the wheel-type and, more generally, the crawler-type. Units of the latter type are regularly equipped with power take-offs at the rear for the operation of auxiliary equipment. The transmission of power to trailing equipment from such units may be accomplished by means of a flexible shaft, while equipment mounted on the tractor is operated by belt or chain drive. The deck of the crawler tractor is readily adapted to the carrying of such equipment as generators and air compressors. The wheel-type tractor is also readily adapted to the transmission of power to trailing equipment, but is less convenient for the mounting of equipment directly on the tractor itself because of the presence of the two rear wheels, which are usually of wide tread and large diameter. Tractors of both the wheel and crawler types are powered with engines suitable for operating auxiliary equipment.

Wheel-Type Equipment

A marked development in the trend toward off-track equipment has been manifested in the more general use of motor trucks and automobiles in place of track motor cars, work trains and other means of transportation operating on the rails, although such off-track equipment is limited to certain phases of maintenance of way work. Automobiles and trucks are as safe and reliable in operation as track motor cars. They are particularly advantageous when employed for the transportation of men and materials at terminals where the operation of work trains and motor or hand cars is expensive because of frequent and extensive delays due to traffic. The use of automobiles and trucks is also advantageous where fixed property that must be served is located at such distances from the rails that it is inaccessible by train or motor car. Moreover, where tracks are parallel to and near the highways much more mileage can be covered in a given time by automobile than by motor car.

Unfortunately, wheel-type equipment is not adapted to operation over the average railroad right-of-way because of the uneven ground and the tendency of the wheels to bog in soft ground. Wheel-type equipment is, therefore, at a disadvantage in territory where highways are not located in close proximity to the track and where the right-of-way is unsuitable for the operation of such equipment. One writer has suggested the possibilities of a roadway within the right-of-way, to be used in place of the tracks for the operation of maintenance equipment and the transportation and distribution of material. Such a roadway would permit more general use of automobile trucks and wheel-type tractors.

Automobile Trucks

In addition to being used for the transportation of men and materials, automobile trucks are also used for mounting work equipment, such as air compressors, concrete mixers, pumps, well-drilling equipment and welding and other generators. For example, one railroad has successfully used an electric-arc welder mounted on an automobile truck in its Chicago terminal for the past two years. The use of this truck has increased the working time of the welding outfit approximately 40 percent, as compared with the productive time that would be possible with a welder operating from the rails. This is accounted for by the saving in the time of moving the machine from one job to another. Although there are as many as twelve parallel main tracks in this terminal no difficulty has ever been experienced in obtaining access to the work with no more than 300 ft. of cable.

The cost of operation of this truck-mounted welder, including the wages of the welder and the grinder operator, and the cost of oil and gasoline for both the welding machine and the gasoline driven grinder, averages about $11 per eight-hour day. These figures apply to frog and crossing welding only.

While air compressors mounted on automobile trucks do not appear to have been used extensively by railroads, there is no reason why the use of such machines at large terminals could not effect material economies.

Wheel-type tractors are adapted to many uses as off-track equipment and are employed extensively by railroads. Heretofore, the application of such units to railway use has been confined largely to the stores and mechanical departments where they are rapidly supplanting the industrial trucks formerly relied upon for handling materials and supplies about mechanical terminals and repair shops. The field for the wheel-type tractor,

Special Attachments Render Crawler Tractors Adaptable to Various Services

The Deck of the Crawler Tractor Is Readily Adapted to the Carrying of Such Equipment as Generators and Compressors

however, is now gradually being extended to other phases of railroad work, including maintenance of way. As with the automobile and motor truck, it is best adapted to use where roadways are available, although the wide tread and large diameter of the rear wheels permit them to be operated under conditions wholly unsuited to motor trucks equipped with standard tires.

A small wheel-type tractor hauling a 1½-cu. yd. dump wagon is regularly employed to haul rubbish from a large freight terminal in Chicago. This tractor makes from 12 to 15 trips per day, the haul being about 1½ miles. The cost over a period of a year averaged slightly more than 27 cents per yard for the material handled. This expense included the wages of the operator and the cost of gasoline, oil and repairs but did not include the cost of loading the material in the dump wagon.

Crawler Tractors

The crawler tractor is best adapted for general service where roadways are not available. The bearing pressure of the treads on the standard crawler-type of tractor is only about five or six pounds per square inch for the sizes commonly used in railroad work, although the weight of the machines may range from 5,000 to 10,000 lbs. The low-bearing pressure of the treads permit these tractors to be operated over snow, through shallow water and on swampy ground. They can travel along any standard-gage railroad track and can cross open-deck trestles or through plate-girder bridges where the gage is standard. They can climb a 1½ to 1 slope with ease and their low center of gravity provides a sizable factor of safety against overturning.

Crawler-type units now in use on railroads consist largely of dirt-handling machines, although a considerable number of the tractors in use are equipped with various power-driven attachments for use in maintenance of way work. Most of these attachments are so designed that they may be removed and others applied as required. Thus the tractor becomes a mobile power plant, flexible in operation, adapted to use in all seasons and capable of moving under its own power over difficult grade and soil conditions.

The Committee on Maintenance of Way Work Equipment of the American Railway Engineering Association has made a study of the use of crawler-type tractors in maintenance of way work, and in its report to the association in 1933, it listed the following attachments that are available for use with crawler tractors:

Air Compressors	Rock crushers
Backfillers	Saws
Booms	Scrapers—dragline
Brooms	Scrapers—rotary
Bulldozers	Scrapers—wheel
Ditchers	Snow plows
Graders	Stump pullers
Hoists	Trailers
Loaders	Wagons
Mowers	Welding generators
Post hole diggers	Winches
Pumps	

The comimttee found that this type of tractor was being used on more than 50 different railroads, in practically every class of maintenance of way work.

An example of the utility of tractors in snow removal is afforded by the practice of a large railroad terminal in Chicago. The equipment used consists of three tractors, one of which is equipped with a bulldozer and another with a front-end loader. The bulldozer is used for piling the snow into windrows, whence it is loaded by the front-end loader into dump wagons and gondola cars. The third tractor is used to haul the loaded wagons to the dumping ground. These machines were first employed in this work in the winter of 1932-33, and proved so effective that they are now used regularly for this purpose. During the summer months these tractors are used in various kinds of maintenance of way work, but in the late fall they are moved to Chicago and held in readiness for handling snow.

A tractor equipped with the bulldozer will clear a snowfall of 4 to 6-in. from a roadway 1,000 ft. long and 20 ft. wide in from 20 to 25 min. The loader will load snow into gondola cars from windrows at the rate of 30 cu. yd. per hour and will load a train of three 1½ cu. yd. dump-wagon trailers in from 5 to 6 min. The cost of operation of the tractors in this service is about $1 per hour each.

During heavy snow storms the three tractors keep the driveways at the terminal open and permit of practically uninterrupted service. Prior to the use of the tractors, the snow removal required the services of several hundred men who performed the work with considerably more delay and with results that were much less satisfactory.

Welding generators mounted on standard crawler tractors are also proving satisfactory for track welding, particularly rail-end welding. At least seven such machines are in use on railroads at this time, four of which are owned by railroads and three by welding contractors. Six of the outfits consist of 300-amp. generators mounted on 25-hp. tractors; the seventh consists of two 300-amp. generators on a 35-hp. tractor.

Crawler Units May be Operated From Low-Side Gondola Cars Equipped With Drop Ends

About two years ago the Lehigh Valley, with a view to developing a welding unit that would be free from the disadvantages of on-track equipment, mounted a welding generator inside a tank-type tractor. To date five of these machines have been constructed and are in service. Each unit consists of a 300-amp. welding generator mounted inside a specially designed tank-type tractor, 15 ft. long, 32 in. wide and 37 in. high, the dimensions being such as to permit the welders to be operated along the tracks through narrow rock cuts and on fills. Power for operating the crawlers in these units is supplied from a 7½-kw. auxiliary generator which supplies energy to two 5-hp. motors geared directly to the crawlers. This generator is also available for driving grinders and other auxiliary equipment. Power for operating the generator is derived from a 65-hp. gasoline engine.

Among other developments in off-track equipment that have been made in recent years is an air compressor mounted on a special type of crawler.

This unit, which is propelled by air motors, differs from the conventional type of tractor in that it has been made much narrower to permit it to be operated between tracks or through narrow cuts. It is 8 ft. long, 3 ft. 6 in. wide and 4 ft. 7 in. high. The total weight is 5,500 lbs. It has a capacity of 105 cu. ft. of air per minute at a pressure of 100 lbs. per sq. in. The rate of travel is 88 ft. per min.

Compressors are also available on standard tractors in rated capacities ranging from 140 to 320 cu. ft. per min. piston misplacement and with pressures ranging from 90 to 100 lbs. If greater capacities are desired, they can be obtained by mounting two compressor units on the larger sizes of tractors. The use of equipment of this kind eliminates the necessity for long pipe lines and crib set-offs. Another advantage is that it can be loaded under its own power on push cars or flat cars.

An outstanding example of the use of crawler equipment in railway work is afforded by a recent project for the construction of a steel viaduct 3,500 ft. long, having a maximum height from the ground to the top of rail of 80 ft., with an average height of 50 ft. The crawler equipment used on this job consisted of a 10-ton crawler crane with a 36-ft. boom, which was used in excavating and pouring concrete; another 10-ton crawler crane with a 36-ft. boom, which was used for driving foundation piles; and a 15-ton crawler crane with a 60-ft. boom which was used for erecting viaduct towers. By using the crawler equipment on this project, the work was speeded up about 100 per cent and marked economies were effected. Without the crawler equipment it would have been necessary to use track derricks or stiff-leg derricks, with resulting delays because of the necessity of clearing for train movements and of moving the stiff-leg derricks. As it was, the use of the track derricks was confined to the work of placing the girders and the deck.

Crawler Cranes

Crawler cranes are adapted to almost any class of ditching or material-handling work. They are also effective in handling ballast, refuse, cinders, coal and snow, and may be adapted to the loading and unloading of rail, the handling of frogs, and, when equipped with magnets, they are effective in handling special track material and scrap. They may be operated either from the ground, or from flat cars or low side gondolas with drop ends, being moved to and from the cars under their own power.

Summing up the more important advantages in the use of off-track equipment, particularly the crawler tractor, we have the following:

1—Offers minimum interference to rail traffic.

2—Utilizes the maximum effective working time of the equipment.

3—Is applicable to use at points not served by tracks.

4—Can be loaded on cars under its own power or moved along the right-of-way independently of the track.

5—Is adaptable to the use of small gangs.

6—Is suitable for work during all seasons of the year.

How Cold Weather Affects Paints*

By C. Miles Burpee,
Research Engineer,
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REGARDLESS of how impervious to air or water a paint film may be, or how closely it adheres to a steel surface, if it does not possess sufficient elasticity to accommodate itself to the expansion and contraction of the metal during periods of maximum reaction to temperature changes, failure will result. There are extremes in the contraction and expansion of metals through which no paint film will pass unharmed. But in general, a good paint, suited to the purpose for which it is used, and properly applied, will give satisfactory results through the natural temperature range of the northeastern section of this country.

A detailed inspection of the paint films on many bridges, of varying ages up to 10 years, was made during the spring of 1934 after the particularly cold weather of the previous winter, but only a single failure was revealed. In this instance a good paint had been applied over an old film which, after casual observation, apparently had been considered in good condition. The failure consisted of checking, cracking, scaling and flaking, which exposed the bare steel. The cause was the lack of sufficient elasticity in the old film. The primer was indeterminate, but was not red lead as was found on the other bridges of the group which had been painted by the same gang, using the same recoating materials, during the same period.

The effect of the cold weather last winter was especially noticeable in the flaking of paint coatings from galvanized iron and zinc-coated metals of bulletin boards, dwellings, box car roofs and gasoline filling stations. Paint films may ordinarily be applied to galvanized surfaces with general assurance of success by first using proper washes and primers, or by allowing a few months of weathering prior to painting. Apparently the greatest failure was upon surfaces which were covered with many different coats of paint of varying composition.

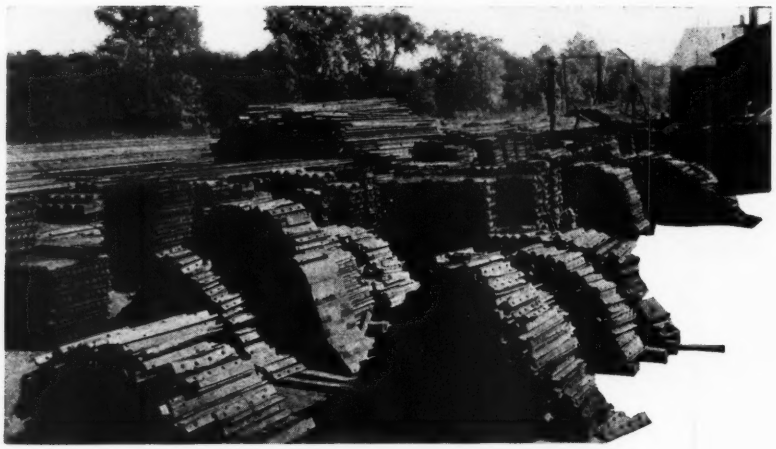
Heated Surfaces

In other instances, flaking occurred on properly painted galvanized surfaces, the backs of which were heated. Several instances of this nature were noticed on sheet and plate steel of locomotives where failure was limited to portions of the cab or engine in which the difference in temperature, between the paint film and the interior surface of the steel, was considerable. Ordinarily, at room temperature, a good paint film will elongate enough to accommodate itself to the corresponding expansion of the steel to which it adheres, but with age this elasticity will be greatly reduced. A sudden change in temperature may cause a rapid reaction in the steel, however, so that it is important that prime and finish coats be of such composition as to insure adequate elasticity in the dried films and that, where paints of this nature are used for repainting, an application should never be made over old films of many coats which have been partially disintegrated by weathering and consequently are lacking in elasticity.

The painting of wood surfaces presents different problems, but success still depends to a large degree upon the elasticity of the film. Moisture may be present in wood in two forms, first, as free moisture within the cells and, second, within the cell walls or wood tissue. The proper air seasoning of green lumber may

(Continued on page 288)

*This discussion was submitted for publication in the What's the Answer department in the January issue, but because of its scope, it was withheld for presentation here as an independent article. For further discussion of this subject, see page 39 of the January issue.



A Railroad Stock of Joint Bars

Rail Joints

Can They Be Standardized?

This is the sixth article of a series dealing with the multiplicity of designs in track materials and tools as follows:

No. 1 Nov. – General Problems
No. 2 Dec. – Rail
No. 3 Jan. – Track Wrenches
No. 4 Feb. – Tie Plates
No. 5 April – Lining Bars, Tamping Bars and Claw Bars
Adzes will be discussed in June.

NO DEVICE used in track construction has been characterized by such a multiplicity of designs or by such frequent changes in design as the rail joint. It exceeds in these respects both rail sections and tie plates, which have in themselves been characterized by many designs. A recent survey of a selected list of roads disclosed the fact that they have more than 1,000 different designs of rail joints in current use. As an indication of the frequency with which they have changed designs, even within recent years, one mill has rolled more than 1,000 designs since 1914, live rolls for 154 of which are still being maintained. During the same 20-year period another mill has rolled 274 joint bow sections, to which 4,513 punchings have been applied, and at present is maintaining live rolls for 120 sections and live punching equipment for 2,500 different combinations of punchings. These conditions can be duplicated at almost every mill in the country.

In what ways do rail joints differ? Obviously, they vary with the section of rail with which they are to be used, for a rail joint must have a contour which will fit the fishing surfaces of the rail. Likewise, the "fishing" height of the joint is made greater than the corresponding height of the rail to insure a wedging effect against the fishing surfaces when the bolts are tightened. Attempts to make the rail joint approach the strength of the unbroken rail and to increase its efficiency have led to the introduction of special features of design, such as increased section, particularly in the head, base support for the rail, deformation or reinforcement of the flange to provide additional support under the rail gap, provision for a bearing only on the fillet of the rail, and symmetrical sections which omit the flange, as well as wide variations in the general contour of the section.

Drilling Practice

In addition to these variations in basic designs, there is also a wide difference in practice with respect to the drilling required for the bolt holes. These drillings differ with respect to the spacing and height of the bolt holes, the manner in which the bolts are staggered, the size of the bolts and the shape and size of the shoulder of the bolts. The accompanying table of drillings for nine sections of rail, two of them very recent, which are required of a single manufacturer gives only a slight indication of the total number of variations that are found in this one feature of rail-joint practice. It will be noted that 307 combinations of drillings are possible for the location of the bolt holes only. When the differences in the stagger of the bolts, in their diameter and in the size and shape of the shoulders are added, these combinations are multiplied several times.

Aside from these drillings, this same manufacturer is rolling 72 different joint bars for the nine rail sections shown in the table. In this connection, it should not be over-

looked that the foregoing data refer to a single manufacturer and to only a few of the heavier rail sections. In addition, there are literally hundreds of rail-joint sections and drillings for the older and lighter rails.

As an illustration of the possible variations in design, attention is directed to the composite drawing of eight joint-bar sections for 110-lb. RE rail, any one of which may require any of the drilling combinations referred to. In making the survey already mentioned, 9 different designs of joints were found for 130-lb. RE rail, and on 15 roads which were using a single design of joint for this rail there were 17 different drillings. Again, 10 different rail joints were found for 110-lb. RE rail, and 25 roads which were using the same design of joint for this section had 25 different drillings.

Effect of Multiplicity

These facts lead to a consideration of the effect of this multiplicity of designs for rail joints and the extent to which a reduction in the number of designs would be of advantage. As with those materials which have been discussed in previous articles of this series, there are two parties at interest, the railway and the manufacturer, so that the question must be considered from the two view points.

There can be little question that if all designs of rail joints were of equal merit, it would be of decided advantage to any road to have a single design of joint for each section of rail in service. This is particularly true of the drilling, as differences in drilling may be the source of much confusion in the distribution of material for replacement purposes. Furthermore, one drilling for each rail section would tend to reduce the stock carried by the stores department.

It is well known, however, that all designs do not have equal merit, for while some give satisfactory service others fail almost completely. If a design proves unsatisfactory, it is certainly of advantage to replace it with a better one. Likewise, if a design is developed which is better than one that has been giving reasonable satisfaction, the advantage of adopting it can scarcely be questioned. So far as the local problems of maintenance are concerned, it is not highly important whether a road adopts a single design or employs a diversity of designs, so long as it does not change its rail drilling or the length of the bolts.

Is there any advantage in two or more roads using the same design of rail joint? So far as the local problems of maintenance are involved, the practice on one road with respect to rail joints has no affect on others, since track materials are not interchanged. Against this, if several roads are using the same design, it may be easier to obtain rollings of a common section, particularly if their individual requirements are small.

Number of Variations in the Drillings for Nine Rail Sections

Rail Section	Number of variations Base to center of hole	Longitudinal Spacing: Number of variations for four-hole punching	Longitudinal Spacing: Number of variations for six-hole punching
131-RE	3	5	3
130-RE	2	16	5
130-PS	1	5	1
112-RE	1	2	1
110-RE	3	8	1
100-RE	5	10	1
100-RA	2	16	4
100-RB	2	15	6
90-RA	4	15	2

Broader Aspects

These are matters of local interest. There are broader aspects to the question, however, which have a direct bearing on the cost of materials. To obtain a measure of the broader question of economy, we must turn to the manufacturer and find how a multiplicity of designs affects him and how they react through him on the railways as a whole.

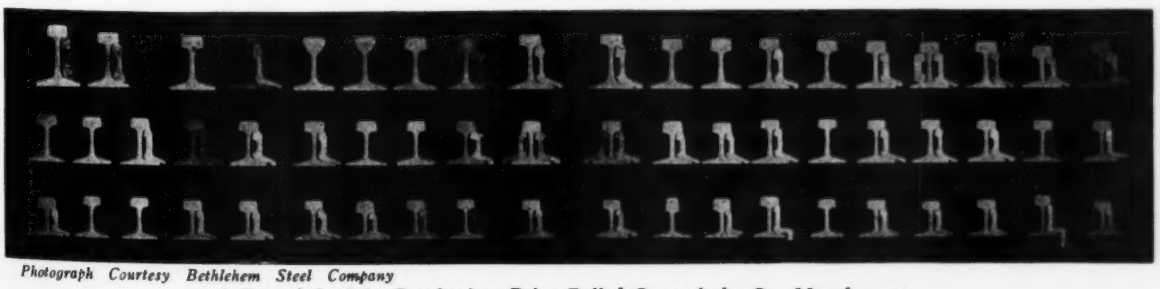
Every mill must maintain a set of rolls for every joint-bar section it produces and also a full set of punching equipment for every different rail drilling. A full set of rolls costs from $6,000 to $14,000, depending on the size of the mill and including the necessary spares, for every primary set of rolls must be protected by a duplicate set to insure against delays in the event that one or more of the rolls in the original set breaks or is otherwise damaged while in use, since it requires from four to six weeks, and in some cases as much as eight weeks, to make up a set of rolls.

A set of rolls for producing rails has an average life of about 25,000 tons, and requires dressing at intervals of 1,500 to 1,600 tons. On the other hand, the approximate life of a primary and duplicate set of rolls for rail joints is 15,000 tons and, in general, they must be redressed when 400 tons have been rolled. The new A.R.E.A. design of joints for 112-lb. rail requires a dressing of the rolls after not more than 100 tons have been rolled, owing to the limited tolerance permitted. It will be seen, therefore, that as the tolerances are reduced, more spares are required to avoid delays to operation during the redressing of the rolls, with a resulting increase in the cost of the set and of the dressing.

Number of Designs

Any section of rail may have as many as 15 or more designs of joint bars today, and it is not uncommon for a single railway to have as many as a half dozen designs of joints for a single section of rail. If, as often happens, a road designs a rail joint and, after ordering a relatively small tonnage, prepares a new design, the manufacturer is left with a useless set of rolls on his hands, which he must retain since he never knows whether the latest design will supersede all former designs, or when he may be called on to roll the apparently obsolete joint.

In this connection, it must also be borne in mind that few roads purchase all of their rail joints from a single manufacturer, but divide their orders among several mills. For this reason, the number of rolls and the losses sustained when designs are superseded must be multiplied by the



Photograph Courtesy Bethlehem Steel Company

A Few of the Joint Bar Sections Being Rolled Currently by One Manufacturer

number of mills with which the road places its orders.

Nor is the problem confined to the rolls, for a different set of punching dies and tools is required for every change in the spacing or the height of the bolt holes, as well as for every change in the size or shape of the holes in the joint bar and a full set of these dies and tools costs about $300. Also, whenever a new combination of punching is required, the dies must be changed, at a cost of $30, while the machines are kept out of production for about two hours. Since a section of rail may have as many as 15 or more joint-bar sections and individual roads as many as a half dozen drilling combinations, it will be seen that the drilling may be as much of a problem to the manufacturer as the shape of the section. That this problem is not confined to the older designs is shown by the number of drillings already demanded for the new A.R.E.A. 112 and 131-lb. sections which are not yet two years old. It is because of this condition that some manufacturers have a larger investment in punching equipment than in rolls.

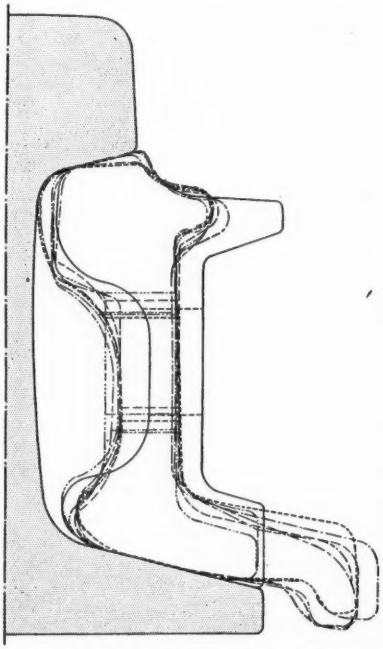
In not a few instances the drilling is changed without altering the section of the bars. In some cases roads which have used certain drillings for a number of years have changed the spacing by only 1/32 in., making necessary complete changes in the drill blocks at the rail mill and similarly affecting the punching equipment for the joints. In another case, a road changed the shape and size of the bolt holes for its joints for a single section of rail every year for four years, the spacing remaining constant.

Effect on Railways

It is evident from the foregoing that both multiplicity and frequent changes of design increase costs of production. Conversely, the adoption of identical designs by several roads, and particularly of a single drilling, for each rail section, will reduce costs. Such action will be of advantage to the railways, because whatever adds to the cost of manufacture also adds to the sales price of the product, since no manufacturer can long remain in business who fails to pass on to his customers all of his costs for rolls, dies, etc.

It should also be borne in mind that for the same commercial reasons that have been mentioned in preceding articles of this series, the original cost of a set of rolls and of punching equipment, cannot be assessed directly against the road placing the order, but is spread over the entire output of the mill, thus penalizing all roads, even though only a relatively few may have caused the greater part of these costs.

Since the advantages of reducing the number of designs for rail joints is apparent, we are faced with the question whether a reduction is practicable and, if so, how it can be brought about. As was shown in the article on the standardization of rail, in the December issue, 69 different weights and approximately 400 sections of rail still remain in the main tracks of the Class I roads alone. There are many times this number of joint-bar sections and drillings for these older designs of rail, and as long as they remain in service it will be necessary to supply rail joints to fit them.



Eight Different Designs of Joint Bars for 110-Lb. R. E. Rail

As these older rail sections are worn out and discarded, the number of rail-joint sections and the wide variety of drillings will be reduced automatically. It will be many years, however, before all of these older designs pass out of existence, as is clearly indicated by the fact that only 16 per cent of the main-track rail in Class 1 roads weighs 110 lb. or more per yard, while 42 per cent weighs less than 90 lb., 23 per cent is lighter than 80 lb., and 11 per cent is lighter than 70 lb. In other words, there are still in main tracks more than 111,000 miles of rail lighter than 90 lb., and of this almost 62,000 miles are lighter than 80 lb.

In contrast with this situation, there has for a number of years been a definite trend toward reducing the number of new designs although, as has been shown, this number is still large. One reason for this trend lies in the smaller number of new rail sections that are being developed currently. Again, by reason of heavier joint-bar sections, deeper fishing, the use of heat treated bolts and the greater stiffness of the heavier rail sections of today, modern rail joints are giving so much better service than those of 30 years and more ago that much of the incentive to develop new designs has been removed.

A.R.E.A. Studies

Furthermore, the intensive study of rail joints that the A.R.E.A. Committee on Rail has been making for several years, and the work that it has done in the way of designing joints for the new 112 and 131-lb. rail sections, has done much to harmonize designs. It is reasonable to expect that the work of this committee will lead to a still further reduction in the number of new designs.

With this situation in mind, we are led to inquire whether standardization is practicable. Excluding the designs of joints for the older rail sections, which, obviously, must be continued as long as these rails remain in service in either main track or sidings, it would appear, first of all, that there is no reason why the drilling of the newer sections, say for 100 lb. and heavier, cannot be reduced to a rigid standard and applied to all new rail. If this were done, it would be necessary to apply the present diverse punchings only to such joints as may be required for replacements on rail now in service.

In view of the considerable reduction that has already been made in the number of designs for rail joints, there are those who contend that the shape of the section can also be reduced to a rigid standard. They point out that, despite the efforts that have been made to standardize rail design, the full benefits that will come from the acceptance of such standards will not be realized unless restraint is exercised with respect to the multiplication of designs for joints for these standard rails.

They also point out the many inconsequential differences in the various designs which do not affect the service value of the bars and contend that there is no reason why these differences cannot be compromised. They also contend that the principles of design are now well established and that since the different designs are only variations of a basic type, there is no reason why a single standard cannot be developed for each sec-

tion of rail, which will be equally satisfactory to all roads using that rail.

Those who oppose rigid standards admit frankly that the present multiplicity of designs is undesirable. They take issue, however, with the statement that the principles of design are well established, and maintain that while the fundamentals of design are better understood than formerly, we have by no means attained the ultimate in this field, and that rigid standardization will retard, if it does not stop, further development.

They also call attention to the fact that credit for much of the progress in rail-joint design must be given to manufacturers. They believe, therefore, that progress from this quarter will be arrested, if not eliminated, by rigid standardization and that the railways will lose the advantage they now enjoy as a result of the ingenuity of the manufacturers, thus closing an important channel leading to improvements in design.

Are Roads Willing?

In view of the waste created by the present multiplicity of designs and of the objections that are raised to rigid standardization, will the roads be willing to accept any one standard for rail-joint design? It would appear that there should be no serious objection to reducing the drilling of the rails and the punching of the bars to a rigid standard, which in itself will bring about a large measure of economy.

It is not debatable that the work of the Rail Committee of the A.R.E.A. has been of great value in this connection or that it is a step in the right direction. On the other hand, there are those who question whether the committee has allowed enough latitude to gain maximum acceptance for its designs. Preferences are so thoroughly grounded with reference to certain major features, such as flanged joints or angle bars, base support, symmetry and fishing contacts, that it is not surprising that these features persist. On the other hand, it would appear reasonable to expect that within these general types many minor variations might well be compromised to reduce the total number of designs to a few that would, within a reasonable time, gain wide acceptance.

Is standardization beyond this point necessary for economy? There is little disadvantage to a manufacturer in a limited diversity of designs, provided he is assured of a sufficient tonnage of each design to wear out his rolls within a reasonable time. If the designs are reduced to the relatively few which would be necessary to incorporate the major features which have been mentioned, the number of rolls would be reduced correspondingly. By reducing the designs in this manner, substantially no greater investment in rolls would be required than by rigid standardization, for the rolling to a single design of the tonnage normally required necessitates several sets of rolls.

If the number of designs can be reduced to a few, manufacturers will be able to effect the same economy in production that would be possible through concentration on a single design. At the same time, if this reduction is made in such a way as to provide a suitable selection of designs to meet the varying needs of the roads, they can be made to retain all of the fundamental features of the designs which they replace, and thereby win more universal acceptance. Simplification in the design of rail joints possesses, therefore, all of the advantages of rigid standardization, without its disadvantages.

Trends in Capital Expenditures

THE changing character of the capital expenditures made by the railroads is reflected in a tabulation of such expenditures for the years 1922 to 1933, inclusive, which has been compiled by the staff of Joseph B. Eastman, federal coordinator of transportation. Incidentally, this tabulation shows that while the total yearly expenditures for additions and betterments were declining during the depression, the proportion of such expenditures for roadway and structures was increasing steadily so that in 1933, expenditures for this classification amounted to 85.1 per cent of the total, as compared with 14.9 per cent for equipment.

Table I is a compilation of capital expenditures for roadway and structures during the period in question, which shows the amounts expended under the major classifications.

Table II illustrates the comparative magnitude of capital expenditures for roadway and structures and for equipment. The figures in this table show that in the years prior to 1925, capital expenditures for equipment consistently exceeded those for roadway and structures but that subsequent to that year expenditures for the latter classification have not only occupied first place but have continued to increase relative to equipment expenditures. Thus, in 1924, roadway and structures expenditures amounted only to 43.6 per cent of the total, as compared with 56.4 per cent for equipment; while in 1933, these figures were 85.1 per cent and 14.9 per cent, respectively.

Table I—Capital Expenditures for Roadway and Structures, Class I Railways, Excluding Switching and Terminal Companies

Year	Additional track	Heavier rail	Additional ballast	Shops and engine houses	All other improvements	Total roadway and structures
1922	$ 50,327,000	$ 16,875,000	$ 5,421,000	$ 13,635,000	$ 97,507,000	$183,765,000
1923	108,745,000	27,866,000	9,471,000	51,214,000	180,129,000	377,425,000
1924	116,725,000	32,037,000	10,825,000	39,834,000	181,714,000	381,135,000
1925	145,757,000	32,952,000	11,665,000	31,345,000	188,358,000	410,077,000
1926	166,758,000	42,184,000	16,519,000	46,882,000	240,821,000	513,164,000
1927	139,175,000	43,742,000	16,230,000	35,236,000	248,468,000	482,851,000
1928	116,494,000	47,193,000	15,748,000	24,323,000	248,606,000	452,364,000
1929	129,148,000	46,862,000	17,049,000	36,561,000	302,795,000	532,415,000
1930	114,486,000	47,101,000	11,455,000	29,179,000	342,118,000	544,339,000
1931	64,535,000	29,341,000	5,319,000	9,041,000	180,571,000	288,807,000
1932	22,304,000	12,047,000	2,809,000	3,127,000	90,536,000	130,823,000
1933	14,500,000	15,862,000	1,999,000	2,391,000	53,741,000	88,493,000

Table II—Expenditures for Additions and Betterments to Railway Property, Class I Railways, Excluding Switching and Terminal Companies

Year	Total Capital Expenditures	Roadway & Structures Expenditures	Percent Total	Equipment Expenditures	Percent Total
1922	$ 429,274,000	$ 183,765,000	42.8	$ 245,509,000	57.2
1923	1,059,149,000	377,425,000	35.6	681,724,000	64.4
1924	874,744,000	381,135,000	43.6	493,609,000	56.4
1925	748,191,000	410,077,000	54.8	338,114,000	45.2
1926	885,086,000	513,164,000	58.0	371,922,000	42.0
1927	771,552,000	482,851,000	62.6	288,701,000	37.4
1928	676,665,000	452,364,000	66.9	224,301,000	33.1
1929	853,721,000	532,415,000	62.4	321,306,000	37.6
1930	872,608,000	544,339,000	62.4	328,269,000	37.6
1931	361,912,000	288,807,000	79.8	73,105,000	20.2
1932	167,194,000	130,823,000	78.2	36,371,000	21.8
1933	103,947,000	88,493,000	85.1	15,454,000	14.9
Totals 1922-33	$7,804,043,000	$4,385,658,000	56.2	$3,418,385,000	43.8

Roofs

How Asphalt Shingles Are Laid

WHILE asbestos shingles are applied on main-line passenger and combination stations in the more important communities, there are many smaller stations on main and branch lines for which asphalt shingles are considered suitable. These shingles are also used by the Northern Pacific on section houses, signal maintainers' cottages, interlocking towers and other buildings of similar importance.

The general section in the manual covering the application of this type of roofing includes the preparatory work and the materials to be used, as follows:

Asphalt shingles shall not be applied to roofs having a slope of less than four inches to the foot.

They shall not be laid over green or unseasoned roof boards. Roof sheathing should be uniform in width, which should not exceed six inches.

Before applying the shingles, the roof surfaces shall be swept clean and all loose boards shall be nailed securely in place. All knot holes and all cracks or other openings ¼ in. or more in width shall be covered smoothly with sheet metal nailed securely along one side only. All nails or other projections that might pierce the shingles shall be removed.

Asphalt shingles shall not be applied when rain is falling or during weather cold enough to prevent the work being done properly.

Material Protected

All material shall be housed or covered to protect it from the elements or other sources of damage.

Asphalt shingles shall be of the three-in-one strip type, 12 in. wide, not less than 32 in. long, and surfaced on one side with crushed slate or other suitable material of natural green color. They shall comply with the Northern Pacific's Specifications for Mineral Surfaced Asphalt Shingles.

Mineral-surfaced roll roofing for starting strips, ridge and hip caps, and for valleys, shall weigh not less than 85 lb. per 108 sq. ft., and shall have a mineral surface that matches that of the shingles.

Asphalt-saturated felt shall weigh not less than 15 lb. per 108 sq. ft.

Nails for applying asphalt shingles directly to roof decks shall be galvanized, barbed, 1 in. long, 10 gage, and shall have heads not less than $\frac{7}{16}$ in. in diameter. Those for applying this type of roofing over wood shingles shall meet the same requirements, except that they shall be 1½ in. long.

Nails for fastening down saturated felt sheathing and sheet metal shall be galvanized, barbed, 1 in. long, 12 gage and have heads ¼ in. in diameter.

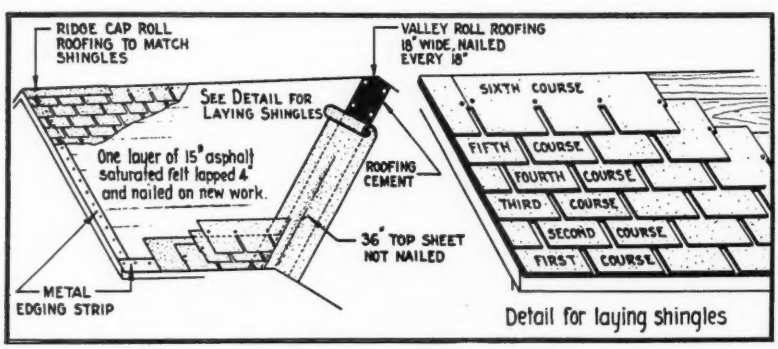
Tin discs, or caps, shall be not less than 1¼ in. in diameter. They shall be flat; bell or cup-shaped caps shall not be used.

Flashing, valleys, eaves and gable-edging strips and other necessary sheet metal shall be 24-gage galvanized pure iron.

Plastic roofing cement shall consist of asphalt containing asbestos fibre, and shall be of the proper consistency to permit it to be worked with a putty knife or trowel.

It is the practice of the Northern Pacific to apply asphalt shingles directly to the roof deck or over old wood shingles, the same as is done with asbestos shingles. The following rules have been issued govern-

In the articles which have preceded this one, the rules adopted by the Northern Pacific for the application of asbestos shingles have been given. The present article, the fourth of the series, covers the instructions appearing in the manual of roofing practices which this road has issued, on the application of asphalt shingles.


RIDGE CAP ROLL ROOFING TO MATCH SHINGLES
VALLEY ROLL ROOFING 18" WIDE, NAILED EVERY 18"
SEE DETAIL FOR LAYING SHINGLES
One layer of 15# asphalt saturated felt lapped 4" and nailed on new work.
ROOFING CEMENT
36" TOP SHEET NOT NAILED
METAL EDGING STRIP
SIXTH COURSE
FIFTH COURSE
FOURTH COURSE
THIRD COURSE
SECOND COURSE
FIRST COURSE
Detail for laying shingles

Sequence to be Followed in Applying Asphalt Shingles

ing the application directly to the roof deck.

Before any shingles are laid, install sheet metal valleys 22 in. wide, placing them so that the metal strips will extend 11 in. on each side of the center of the valley, and nail them sufficiently to hold them in place until the shingles are laid. The shingles shall be laid to expose 8 in. (4 in. on each side of the center) of the valley at the top and 10 in. (5 in. on each side of the center) at the bottom. A small piece should be cut off, at an angle of 45 deg., from the upper corner of each shingle next to the valley. This will prevent the sharp corner of the shingle from protruding beyond the trim line.

Applying Valleys

Where it seems to be more desirable, valleys may be formed of the mineral-surfaced roll roofing, in which event, they should be applied as follows: First, apply a strip of the roofing 18 in. wide, nailing it on 18-in. centers along the edges. On top of this, place a full-width strip, fastening it to the bottom strip by means of plastic cement spread over the entire surface of the latter. Any end seams that may occur in the lower strip may be butted. The top strip should consist of a single piece, but if this is not practicable, the end laps should be not less than 24 in. They should not be nailed, but fastened down with roofing cement. This type of valley construction is shown in the drawing.

Flashing should be installed around chimneys in accordance with the details shown in the drawings. Strips of sheet metal 4 in. wide should be applied along eaves and overhanging gables, which should project ¼ in. beyond the roof boards to support the shingles and form a drip. They shall be nailed on 8-in. centers, and 2 in. back from the edge. Similarly, sheet-metal flashing shall be applied at other points where it may be required.

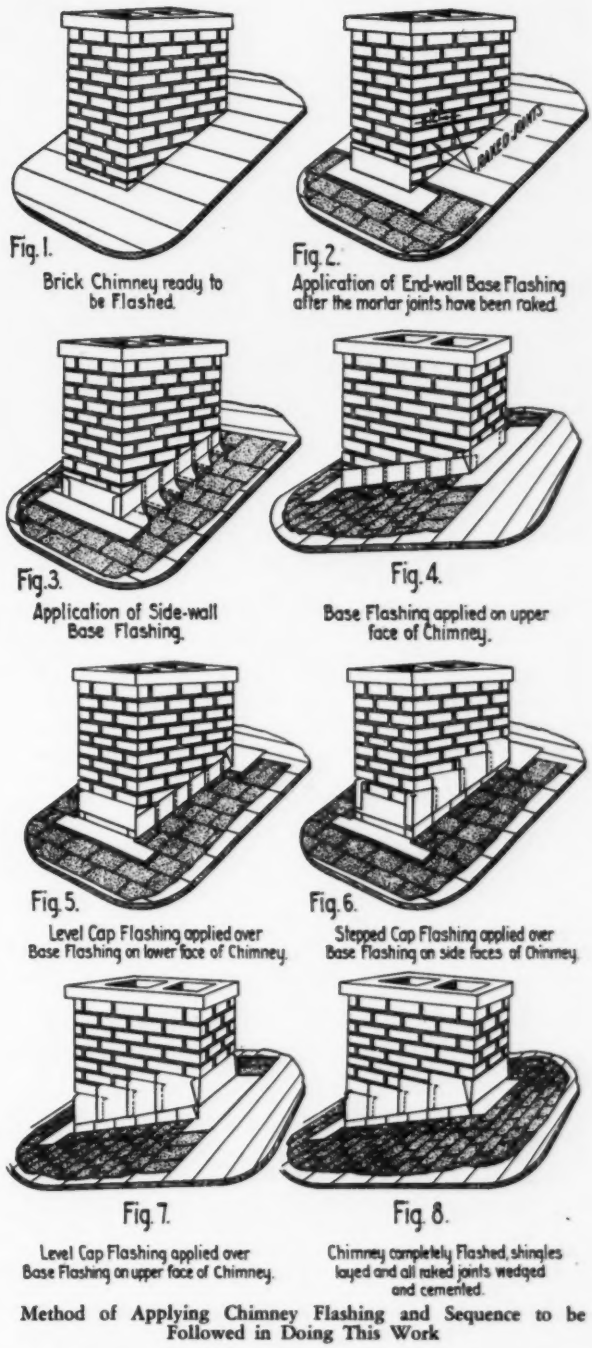


Fig. 1. Brick Chimney ready to be Flashed.

Fig. 2. Application of End-wall Base Flashing after the mortar joints have been raked.

Fig. 3. Application of Side-wall Base Flashing.

Fig. 4. Base Flashing applied on upper face of Chimney.

Fig. 5. Level Cap Flashing applied over Base Flashing on lower face of Chimney.

Fig. 6. Stepped Cap Flashing applied over Base Flashing on side faces of Chimney.

Fig. 7. Level Cap Flashing applied over Base Flashing on upper face of Chimney.

Fig. 8. Chimney completely Flashed, shingles layed and all raked joints wedged and cemented.

Method of Applying Chimney Flashing and Sequence to be Followed in Doing This Work

Preparation of Surface

Over the entire surface to be covered with the shingles lay one thickness of 15-lb. asphalt-saturated felt, lapping all seams 4 in., and nail sufficiently to hold in place until the shingles are applied. The 15-lb. felt shall also be run over all hips and ridges and lapped not less than 12 in.

Start the shingling at the eaves by applying a strip of mineral-surfaced roll roofing 18 in. wide, with the lower edge flush with the drip edge, nailing it on 6-in. centers 2 in. from the bottom edge.

Lay the first course with the end of a full-sized strip shingle placed flush with the outer edge of the metal edging strip on the gable. Start the second course by laying a strip having the first tab cut in half, as illustrated. When this shingle is laid flush with the outer edge of the metal gable strip, the centers of the butts will come directly over the cut out of the first course.

Succeeding courses should be laid by starting the third course with two full tabs, the fourth course with one-half of a strip and the fifth course with one full tab, and the sixth course with one-half of a tab. For the seventh course begin again with a full-sized strip, as for the first course, and repeat these operations until the ridge is reached. It is desirable to strike a chalk line every six courses to insure that the courses are kept parallel with the eaves line. Fasten the strips by placing one nail

above each cut out, and another ½ in. from each end.

Finish the hips and ridges with strips of mineral-surfaced roll roofing cut 8 in. wide and laid 4 in. on each side, nailing on 2-in. centers, ½ in. from the edges, as illustrated.

Asphalt shingles are applied over old wood shingles in much the same manner as asbestos shingles, the difference in the method, as set forth in the manual, being mainly that made necessary by the difference in the character of the two materials. Before the application is made, the warped wood shingles are split and nailed flat as is required when applying asbestos shingles.

Method of Flashing

When applying asphalt shingles, either directly to the sheathing or over old wood shingles, the method of flashing that is outlined and which is illustrated, has been specified for the reason that it requires no special sheet metal work or soldering. The manual provides, however, that other methods of proved worth may be employed where the facilities for doing so are available. It also requires that, before any shingles are applied, the existing flashing shall be checked and replaced where necessary.

The instructions for constructing valleys are the same as when laying the shingles directly to the roof deck, provision being made, however, for the existing valleys to be filled with boards of the proper thickness to bring them level with the surface of the wood shingles before the sheet-metal or mineral-surfaced roofing, of which the valleys are to be constructed, is laid. The remaining instructions are as follows:

The wood shingles shall be removed along the overhanging gables and replaced with boards 4 in. wide, of the proper thickness to bring the top surface approximately to that of the wood shingles. However, preformed metal strips may be used instead of the wooden strips if desired. If used, they shall be nailed on six-inch centers one inch from the inner edge. When ordering metal strips, give the length and the dimensions, A, B and C. The strips shall be painted to match the adjacent woodwork. These two methods are illustrated on page 227 of the April issue in which the method of applying asbestos shingles over old wood shingles was described.

Start the shingling at the eaves by applying a strip of mineral-surfaced roll roofing 18 in. wide, with the lower edge flush with the ends of the wood shingles and nail on 6-in. centers, 2 in. from the bottom edge.

Begin the first course with the end of a full-sized strip shingle laid flush with the edge. Start the second course by laying a strip with the first tab cut in half. When this shingle is laid flush with the edge of the roof, the centers of the butts will come directly over the cutouts of the first course. Succeeding courses should be started as outlined for this type of shingle laid directly on the roof deck, striking the chalk line as suggested in this section of the instructions.

Fasten the strips by placing one nail above each cutout. It is desirable to place the nails one-half inch from the ends of the cutouts, but when applying the asphalt shingles over old wood shingles, this will, of necessity, be varied somewhat, so as to drive into the butts of the wood shingles wherever practicable, to avoid depressing the surface of the asphalt shingles more than is necessary. A supply of laths should be provided for filling in under the asphalt shingles where it becomes necessary to nail just below the butt of the wood shingles. The method of using the lath is shown in the drawings.

Hips and ridges are to be finished with strips of mineral-surfaced roofing cut 8 in. wide and laid 4 in. on each side of the ridge. It should be nailed on 2 in. centers, ½ in. back from the edges.

Maintaining Asphalt Shingles

It is seldom that repairs are required by roofing of this type. Sometimes these shingles will flap in high winds. This is usually confined to patches or to individual shingles, however, and can be corrected by daubing with plastic roofing cement the undersides of those shingles that are causing trouble, and then pressing them into place. In extreme cases it may be necessary to fasten the shingles down by nailing the exposed corners, although this should never be done if it can be avoided. When it does become necessary, a daub of the roofing cement should be placed on the underside of the shingles affected, at the points where the nails will be driven. The same large flat-headed nails should be used as are employed in applying the shingles.

The next article will deal with the methods adopted by the Northern Pacific for applying and maintaining prepared roofing.

Paint in Winter

(Continued from page 281)

eliminate the cell moisture and a part of that within the cell walls, until the wood approaches a state of balance as compared to the surrounding atmosphere.

A good paint, properly applied in thin coats to seasoned wood, produces a film which has a valve-like action, in that it allows the passage of moisture from within the lumber to the atmosphere and a reasonable exclusion of water from the exterior. Atmospheric temperature and changes in humidity effect a considerable variation in the lumber surfaces of buildings and structures, so that considerable care must be exercised in the formulation of paints which will produce successful films for exterior use.

Exterior building paint having a synthetic oil as the vehicle, was applied during May, June and July over new siding, over old siding with the old paint completely removed, and over old linseed-oil films in good condition. The new films were bright and glossy, presenting an excellent appearance and passed through summer, autumn and early winter in good condition. However, evidences of failure were noted in early February, principally in the form of short longitudinal splits or checks, which gradually progressed until the films curled back.

Investigation developed that laboratory tests and the exposure of test panels in Florida had indicated that the synthetic oil produced a much more elastic film than linseed oil and, in the formulation of paints for exposure in this section, advantage was taken of this fact and a comparatively high content of zinc oxide was incorporated. However, this paint gradually failed, and all the surfaces had to be cleaned and repainted. Revised formulas were prepared and the zinc oxide was reduced to less than seven per cent, with the result that the later films are now intact after three years.

The best assurance of an economic paint program, over a period of years, rests upon the selection of good paint of proved merit, judged from its service on buildings and structures after the lapse of suitable time, and its proper application, under competent supervision, to suitable surfaces. The effect of the extreme cold weather and sudden temperature changes of the winter of 1933-34 clearly indicated the need of more careful attention to the preparation of surfaces and the removal of old paint films after they have served their purpose.

Beveling of rail heads at the joint has also been proved of value in increasing the life of both "new" and "built-up" rails

Experience Shows Value of Heat Treatment*

By C. H. R. HOWE

Cost Engineer, Chesapeake & Ohio

THE heat treatment of both new and welded rail ends has a definite value that can be expressed both in rail life and in monetary terms. This conclusion has been arrived at as the result of careful consideration and observation of rail ends so treated over months of service.

The heat treating process is by no means novel, as metals subject to great stresses or abuse, such as shocks, jars and undue abrasion, have been so treated for many years. In the rail joint, the necessity for so strengthening parts is recognized, as is evidenced by the fact that the American Railway Engineering Association has specified heat-treated track bolts. The process of heat treating rail ends consists of hardening the upper surface of the head for a distance of about two inches back from each end. The surface of the head thus treated is about 100 points Brinell harder than the rails coming from the rolls, the increased hardening of the metal tapering off gradually into the head to a depth of from ¼ in. to ⅜ in.

It is a fact well known to metallurgists that iron and carbon are in perfect chemical affinity only at high temperatures, the degree of affinity depending entirely upon the percentage of carbon content and of other chemical elements that may be present. The average carbon content of 130-lb. rail steel is approximately 0.7 per cent. When the rail end is heated to about 1292 deg. F., complete solution of the carbon in the iron takes place. If the temperature were to be reduced instantly to that of the atmosphere, the steel would be a perfect solid solution of carbon in iron and would consist principally of austenite, an extremely brittle formation not suitable for a surface carrying wheel treads. In practice, it is not possible to cause this instantaneous cooling. However, it is approximated by quenching with water until the temperature of the metal drops below the boiling point of water, 212 deg. F.

Changes in Steel

While at 1292 deg., and during the transition from this temperature to 212 deg., three changes take place in the character of the steel. First, the iron and carbon begin to lose complete chemical affinity; second, in so doing, heat is generated which causes recalescence, or afterglow; and third, at the same time the steel assumes magnetic properties which it did not have at high temperature. After the temperature has been reduced by water quenching, the steel produced is not entirely austenite, but is a combination of austenite with other less brittle structures. The steel, however, is still too brittle for the service for which it is to be used, so it becomes necessary to anneal it, or to draw some of the temper from it to make the surface more ductile, or less brittle.

In demonstrating the value of the above process, it was first necessary to ascertain by field test whether the process as applied in other industries was practicable for railway use. The Chicago, Milwaukee, St. Paul and Pacific was the first to undertake this work on a large scale, and now has several hundred miles of rail so treated. The Chesapeake & Ohio did not establish this as a standard practice until it had made careful field tests to prove that the results secured were as valuable as claimed.

In May, 1932, a comparative test of the merits of heat treating and beveling was inaugurated on a section of heavy traffic track. A total of 142 joints, in sequence, were included, as follows:

	Number of Joints
Heat treated and beveled	39
Heat treated, but not beveled	40
Not heat treated, but beveled	37
Not heat treated, not beveled	26
Total	142

*From a paper on, "Oxy-acetylene Process in Railway Maintenance of Way Work," presented before the thirty-fifth annual meeting of the International Acetylene Association.

At the expiration of 16 months, the average batter at these joints was:

Heat treated and beveled	.0034 in.
Heat treated, but not beveled	.0051 in.
Not heat treated, but beveled	.0152 in.
Not heat treated, not beveled	.0152 in.

On the assumption that 1/16 in., or .0625 in. is the permissible limit of batter, the progress of the damage from batter in the case of the heat-treated and beveled joints and those joints not heat-treated and not beveled, was 5 per cent and 24 per cent, respectively.

Comparative Records

It is of interest to note that at the end of the 16 months' record, all of the untreated, unbeveled raid ends were chipped, while only 5 per cent of the heat-treated and beveled ends were so damaged. The particular advantage of beveling is seen in the fact that, of the heat-treated, but not beveled rail ends, 90 per cent showed signs of chipping. The tonnage that passed over this track during the first 16 months of the test was 31,335,000, or an average of 1,958,438 gross tons per month.

At the end of 28 months of this test, the progress of batter had been such that it was necessary to repair certain of the joints, as follows:

Joints Welded	
Heat treated and beveled	None
Heat treated, but not beveled	2, or 5 per cent
Beveled, but not heat treated	26, or 70.3 per cent
Not beveled and not heat treated	25, or 96.1 per cent

It is not logical to assume that the ratio of the rate of batter of the treated ends, 5 per cent, to the rate of batter of the untreated ends, 20 per cent, at the end of the first 16 months of test, or, 4 to 1, means that the life of the heat-treated rails will be four times that of those without heat-treated ends, because under-head wear, surface and line bends, bolt tightness, the character of track surface maintained, etc., have a distinct bearing on rail life. However, with proper attention to maintenance, and the possible application of new bolts and new or reformed joint bars, it should not be impossible to double the life of the rail.

It may be of interest to note the record of the rail in service at the point of the heat-treating test just prior to the installation of the test. This rail, of 130-lb. P.S. section, included 780 ft. laid in April, 1929, and 5,226 ft., laid in March, 1927. The weighted average of the laying time was August, 1927. This rail, which was in the track for 57 months, had all of its ends built up twice, and some of them a third time. During its life it carried 147,926,040 gross tons, or an average of 2,595,193 gross tons a month. Equating the actual life of 57 months to compensate for the lighter traffic over the track during the later period of the test of the rail with heat-treated ends, would indicate a life of 6 years and 3½ months for the earlier untreated rail.

As of July 1, 1934, there were 601 mi. of new rail track on this road that had had the ends of the rails heat-treated and beveled, in addition to 1,239 track miles of rails with rebuilt ends that had been heat-treated. The effect of this work should materially increase the life of the rail and decrease the amount of welding necessary in the future.

The monetary value to the railways, if the practice of heat-treating the rail ends becomes general, will be important, even if the increased life of the rail is far more modest than the results thus far would indicate. There are 280,000 mi. of first main track in the United States, and, if we assume that the average life of rail is 14 years, it would mean that 20,000 mi. of rail is renewed each year in times of normal business. If we assume further that the average weight of rail is 100 lb. per yd., and that the cost of replacing it is $12,800 per mile, minus a salvage value of 25 per cent, we have 20,000 times $9,600, or $192,000,000 as the annual rail bill in the United States. If by heat-treating the ends of new and rewelded rails, we can increase the life of the rail as little as 50 per cent we shall decrease the rail bill by 33 1/3 per cent, or $64,000,000 a year.

The treatment of welded rail is precisely the same as that for new rail, except that a higher temperature

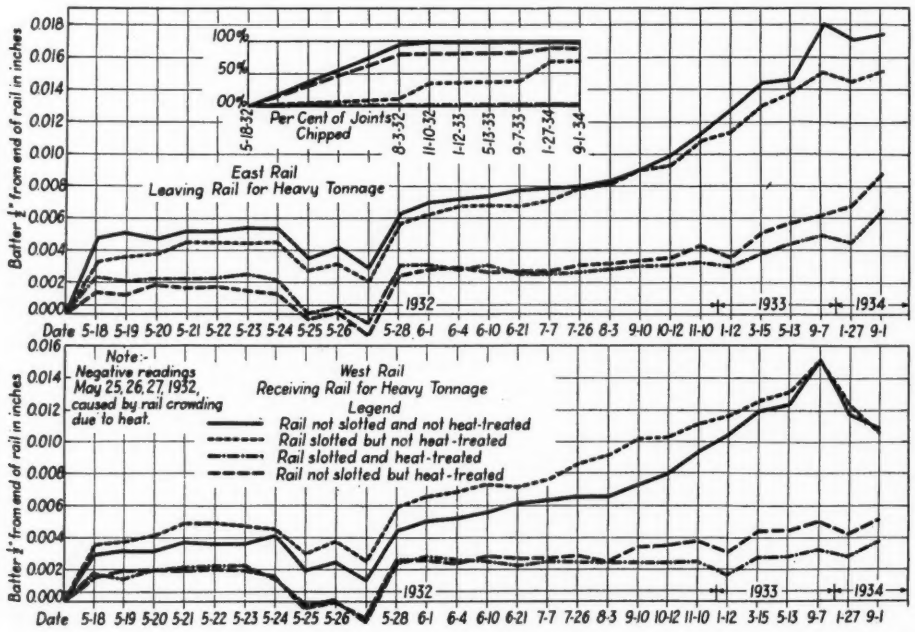


Chart Record of Test Made on the C. & O. of the Heat Treating and Beveling New Rail Ends, Showing Progressive Batter With Different Forms of End Treatment, and Also the Extent of Chipping—51,690,000 Tons of Traffic

The rail, 130 lb. R.E., was laid on May 17, 1932, and the test readings were started May 18, 1932. The rail was heat-treated on the same day it was laid. The conditions under which the test is being made are as follows:

39 joints—Heat-treated and slotted
37 joints—Not heat-treated, but slotted.
40 joints—Heat-treated but not slotted
26 joints—Not heat-treated and not slotted.

of heat is used. This treatment of the welded ends undoubtedly increases the intervals between rewelding. Naturally, this reduces the annual cost for rewelding, inasmuch as the cost of heat-treating and beveling is only about one-third the average cost of the rebuilding of a joint by welding.

Renews Ballast Deck Trestle by Unique Method

AN INGENIOUS method of supporting the rails and ties on a ballast deck pile trestle while a portion of the bents and deck were being renewed was employed recently by the Gulf, Mobile & Northern when it undertook the replacing of 78 bents in a 120-span structure.

The piles, caps, stringers, decking and guard timbers of the spans in question were in such condition that they had to be renewed completely with the exception that the piling below the ground line was still in a serviceable condition. The trestle had settled somewhat so that subsequent surfacing of the track had resulted in an increase in the depth of the ballast under the ties to as much as 12 in. In renewing the structure it was decided to saw off the piles at the ground line and replace the old bents with frame bents in which the caps would be about six inches higher than those in the old structure in order to permit the depth of ballast under the ties to be reduced to six inches without changing the elevation of the rail.

In carrying out the renewal work it was felt that it could be expedited if a clear opening could be provided for the renewal of several adjacent spans at one time. With this thought in mind, the engineering department of the road worked out a scheme whereby two adjacent bents and the three adjoining spans could be entirely removed and replaced simultaneously with new construction without removing or disconnecting the rails and ties and without wasting the ballast. As the spans were slightly less than 14 ft. long this plan required that the rails and ties be suspended over a distance of about 42 feet.

Procedure Followed

The procedure involved first the removal of all the ballast from the deck over the three spans to be renewed. When this had been done a 44-ft. length of rail was placed bottom-side up under each track rail with its base bearing against the bottoms of the ties, these rails being held in place by U-bolts, with the nuts tightened against beveled washers bearing against the bases of the track rails. The U-bolts, of which six were used to each running rail across the 44-ft. span were formed from old truss rods. In order to keep the legs of the U-bolts from spreading they were encased in "cuffs" formed of flattened six-inch lengths of discarded superheater flues. The 44-ft. lengths of rail were formed by fastening together with angle bars two pieces of the necessary length.

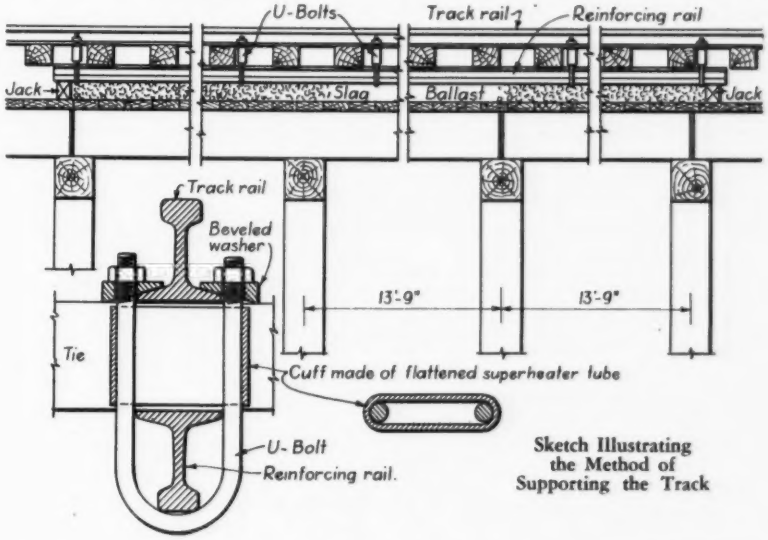
The rail girders thus formed were then jacked up over the two and bents a sufficient amount to give ample space underneath the lower rails for carrying on all work in connection with the removal of the old material and the construction of the new bents and deck. Moreover, this double-rail construction was sufficiently strong to allow loaded push cars to be transferred over it with safety, while it also permitted the men to walk across on the ties without danger of having a tie give way because of loose spikes or the absence of spikes.

With the rails and ties suspended over three panel lengths it was, of course, possible to renew only two bents at a time. Thus, because of the necessity of always supporting the jacks under the rear end of the suspended span on the deck over a new bent, it was possible to move these jacks ahead only two panel lengths at a time.

Staggered Joints Used

Because of the railroad's practice of using 28-ft. stringers with staggered joints in its trestles, it was necessary at the close of each day's work to insert temporary stringers of one-half standard length in the last panel in place of those that otherwise would extend another panel length. On the following morning these short stringers were removed and replaced with full-length stringers as the work proceeded.

The problem of saving the ballast was solved in what was felt to be a highly satisfactory manner by the use of boxes constructed of rough one-inch lumber, which were made one foot deep by one foot wide by six feet long. As the ballast was removed from the bridge deck it was loaded into these boxes, which were placed on the rails at right angles to the track and slid back out of the way when full. When returning the ballast to the track the boxes were simply pushed back on the rails to the point of unloading and dumped. To facilitate the sliding of the ballast containers on the rails pieces of sheet metal were fastened to the bottoms to serve as runners.



Sketch Illustrating the Method of Supporting the Track

This project was carried out under the direct supervision of L. P. O. Exley, chief engineer of the Gulf, Mobile & Northern, to whom we are indebted for the information contained in this article.

What's the Answer?

Should the Cribs Be Cleaned?

When cleaning stone ballast, should the cribs be cleaned as well as the shoulders? Why?

Opinions Are Varied

By L. J. Drumeller
Division Engineer, Chesapeake & Ohio, Hinton, W. Va.

This is a question that has aroused much discussion and difference of opinion. Some months ago I made an investigation of the ballast-cleaning practices on a number of roads and found that in some cases the cribs are not cleaned although in most cases this is done.

Stone ballast is generally cleaned preparatory to giving the track a general surface, the usual procedure being to tamp the old ballast under the ties and use the new ballast for filling the cribs and for dressing. Where this method is followed, there is no question but that the ballast in the cribs should be cleaned; otherwise, dirty ballast will be tamped under the ties where, most certainly, only clean ballast should be used.

Relatively, it is far more expensive to clean the cribs than the shoulder, but the results obtained over a period of years will certainly justify the expense. In the absence of machines for cleaning the cribs, it is advisable to dig the ballast out from between the ties and throw it into the intertrack space or on the shoulder ahead of the ballast-cleaning machines, and then fork it back into the cribs after it has passed through these machines.

Only Solution to Drainage

By W. E. Tillett
Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

This is a controversial question on which diametrically opposing views are held, some of which are doubtless inherited from the days when ballast cleaning was hand work of the slowest and most laborious character and, therefore, expensive almost to the point of being prohibitive. As I see it, one of the important advantages of stone ballast for heavy-traffic lines is the free drainage it affords. As it becomes foul, the drainage is blocked and the water held in the ballast starts the ties to churning, the only remedy for this condition being to clean the ballast.

While the cleaning of the shoulder will greatly improve track conditions for a time, it has been my observation that the trouble is only partly corrected if the cribs are not cleaned and that the shoulders again become dirty in a relatively short time. If, on the other hand, the cribs and shoulders are both cleaned, the track can be put in first-class shape and will remain in good condition much longer, while the intervals between cleanings will be lengthened, as compared with cleaning the shoulders only.

All Drainage Must Be Free

By G. O. Broussard
Roadmaster, Southern Pacific, Morgan City, La.

To maintain good track, the roadbed and ballast must be kept as dry as practicable. This means that water must drain from the cribs as freely as from the shoulders. Free drainage cannot be maintained when the ballast is foul, however, and for this reason, it is just as important to clean the ballast in the cribs as that on the shoulders. Where the ballast is foul, track conditions can often be greatly improved by cleaning the shoulders only, but to do the work in this way is to leave the job only half done. To obtain the fullest measure of benefit from the expenditure for cleaning the ballast, the cribs should be included with the shoulders.

Clean Cribs Essential

By W. J. Driscoll
Extra Gang Foreman, Alton, Bloomington, Ill.

I consider clean cribs as essential to good track as clean shoulders. No trackman will assert that good track can be maintained where the ballast in the shoulders is foul enough to block drainage. If the cribs are foul, water will be held around the ties and and undue amount of labor will be required to keep the track in surface. If this unproductive labor is applied

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answed in July

1. *Is it practical to lay rails of 100-lb. and heavier sections tight? What are the advantages? The disadvantages?*
2. *What details should be given particular attention in the maintenance of a turntable? Why?*
3. *Where double-shoulder tie plates are in use, is there any necessity for gage rods? If so, under what conditions?*
4. *What tools should be included in the traveling kit of a water service repairman?*
5. *What are the most common causes of failure in crossties? To what extent and in what ways can trackmen eliminate or retard these failures?*
6. *Should hot-water heating systems be drained when they are shut down for the summer? Why?*
7. *Should the ends of new rail be chamfered? Why. Should this be done when it is laid or later? Why? If later, how much?*
8. *What causes the brown or gray metallic film which is sometimes found on paint on both steel and wood surfaces? How can it be avoided? How removed?*

to cleaning the cribs rather than to surfacing, conditions will be greatly improved.

When cleaning the cribs, the ballast should be removed to at least one inch below the bottom of the ties. If machines are used, it should be thrown out on the shoulder and forked back after it has been cleaned. If the cleaning is done by hand, the ballast should be piled just outside of the ballast toe line and forked back as the cleaning progresses.

Yes, if Severely Fouled

By J. B. Martin
General Inspector of Track, New York Central, Cleveland, Ohio

One of the principal advantages of stone for ballast is that the voids provide free drainage, thus tending to keep the ballast and roadbed dry. This contributes to the stability of the track and permits the maintenance of good surface under heavy traffic with the minimum amount of raising and surfacing. When these voids become filled with front-end screenings, droppings from cars and other foreign matter, the drainage becomes blocked and this advantage is lost, the result being churning track. At this stage the shoulders of the ballast require cleaning, and if the cribs are severely fouled they should be subjected to a cleaning operation also.

It is expensive to clean the cribs and, in general, it is not practicable to clean them much below the bottom of the ties. For this reason, they are often allowed to go without cleaning, because on a large mileage of track, conditions can be greatly improved by cleaning the shoulders and the ballast in the inter-track spaces to full depth without touching the cribs. A decision with respect to cleaning cribs must be based on experience and good judgment, taking into consideration all local conditions, the degree of foulness of the cribs and the amount of money available for cleaning the ballast.

Economy of Central Heating

Under what conditions is the economy of steam or hot water, as compared with stoves, for heating small stations sufficient to warrant the installation of plants of this type? Under what conditions are they not justified?

No General Rule Applies

By A. T. Hawk
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

No general rule can be stated from which one can determine when a central heating plant is justified to replace stoves in a small station. If a station requires three or more stoves to heat it properly, additional help may be necessary to tend the fires. Stoves require considerable floor space, are dirty and are somewhat of a fire hazard. The heat given off is not distributed uniformly, for which reason it is usually too hot near the stove and too cold along the sides of the room.

A central heating plant located in the basement, or in a pit in the baggage room if there is no basement, will eliminate the dust and dirt of the stoves in the waiting room and office. Because the firing is concentrated at one point, less attendance is required to keep the fire going. If the plant is large enough, the installation of a stoker will create a more uniform heat, and at the same time reduce the fuel consumption. Such a stoker should be automatic in operation and require the minimum amount of attention. If the heating system is either steam or hot water, the desired temperature in the rooms can be assured by the use of thermostatic regulating valves, with the stoker automatically regulated to suit the heating demand on the boiler.

Where gas or fuel oil is employed in a central plant of either the steam or hot water type, it can be regulated to deliver the same uniform heat as is possible with coal. For this reason, the choice between these three fuels usually will depend on their availability, the amount of attention that must be given to the plant and their relative cost.

In general, a hot-water system is preferable where the boiler and radiators are relatively close together, and where the amount of radiation is small. On the other hand, if considerable radiation is required, particularly if some of it must be located at a considerable distance from the boiler, steam is preferable. The reason for this is that small hot water plants depend on gravity, or convection, for circulation, which is too slow to care for either large or distant radiating surfaces.

At small or unimportant stations, central heating plants are not justified when the overall cost is greater than that of stoves. At such stations, additional help is rarely required for attendance, while heat is seldom necessary for the full 24-hr. period, and in many cases the stations are closed on Sundays and holidays.

Determining Factors

By Frank R. Judd
Engineer of Buildings, Illinois Central, Chicago

A decision as to whether a steam or hot water heating plant shall replace stoves in a small station must be based on a study of several determining factors, including the location, the size and arrangement of the rooms, the periods of occupancy, etc. It may be that the building is isolated, making regular attendance difficult, if not impracticable. In this event it would be inadvisable to install either steam or hot water, owing to the possibility that the plant may be damaged by freezing.

If only one or two rooms are to be heated and they are of such size that this can be done with a circulating heater, it may be advisable to substitute this type of stove for those of the ordinary type. On the other hand, if the building contains several rooms of such size that each one requires an independent stove or circulating heater to obtain the proper distribution of heat, consideration should be given to a central heating plant of either the steam or hot water type. Again, regardless of whether the building is large or small, the interior arrangement may be such that a central heating plant may be more economical and serviceable than separate stoves or circulating heaters installed in each room.

A factor of importance in deciding on the system of heating for small stations is the time of occupancy. If a station is occupied only 8 to 12 hr. a day and is closed from 12 to 16 hr., as is customary at many small stations where operators are not on duty at night, it is not advisable to install either a steam or a hot-water heating plant, unless frequent attendance can be provided at no extra cost. On the other hand, it may be practicable to employ an oil or gas-fired boiler, using automatic control.

It will be seen from the foregoing that each case is an individual one requiring close study in which all factors likely to affect operation and maintenance should be given full consideration. The use of ordinary stoves and circulating heaters should be avoided wherever a central heating plant can be justified, especially

where the stoves are accessible to the public, as in waiting rooms. Central heating plants can be located in rooms where employees are available to attend them properly and only they have access to them.

Conditions Vary Widely

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

There are so many conditions surrounding the heating of small stations that each case becomes an individual problem, for which reason the answer is not so simple as the question would seem to imply, and no general rule can be formulated which will apply to more than a relatively few of these cases. A general principle, which can be used as a guide, but which is not always the deciding factor, is that a central heating plant can be justified only when it will demonstrate greater economy than stoves.

In the South there are many stations where the requirements for heating are for such a short period that the operation of stoves is cheaper than the overall costs of a central heating plant, although some of these stations are of sufficient size to warrant the installation of central plants if the heating period were of longer duration. In fact, such plants are sometimes installed for reasons other than that of relative economy.

In other cases, where the stations are located far from the coal fields so that the cost of transporting the coal is high, oil may be available at low cost. Under these conditions, the ability to use the lower cost fuel in the central plant may be sufficient to warrant the installation, which could not have been justified under other circumstances.

In general, it is more economical to heat small stations from a central plant when such stations are occupied continuously by an office force or where telegraph operators are on duty day and night, provided there are two or more waiting rooms. If separate express or baggage facilities are required, the economy of such a plant will be increased. A station of this class, although it may be relatively small, will require at least three stoves and may call for as many as five. This number of stoves practically always makes it necessary to employ additional help during the winter to keep the fires going, although the attendant may be able to perform other duties.

If a steam or hot water plant is substituted for the stoves, the firing will be concentrated at one point. The coal storage should be adjacent to the plant, so that no time will be lost in carrying coal, which accounts for considerable of the time and labor involved in tending to the stoves. With few exceptions the regular office force can keep the boiler fired without serious interference with their other duties. Sometimes steam for heating can be supplied from a pumping station or other boiler plant.

Some stations remain open only 8 to 12 hr. a day. Obviously, a central heating plant cannot be justified at such points unless the conditions are exceptional or for reasons other than economy. In some cases where an operator is on duty 24 hr., only the office requires heating because passenger schedules require the waiting rooms to be heated for short periods only. Here, again, a central heating plant could not be justified although the office may do a relatively large amount of business.

From the foregoing it will be seen that the conditions at different stations are so varied that each case must be studied and decided on its own merits, and that no general rule can be applied, which will fit all cases. While, as a rule, economy should be the principal consideration, other factors may be of sufficient weight to affect the decision.

Filling High Trestles

When filling a high trestle, should the longitudinal and tower bracing be left in place? The sway bracing? Why? If not, when should they be removed?

Make Fill Uniformly

By H. Austill
Bridge Engineer, Mobile & Ohio, St. Louis, Mo.

When filling a high trestle, it is important that the fill be made uniformly from end to end of the structure, to avoid the possibility of a slide or longitudinal movement of the filling material. When the fill is brought to the height of the longitudinal bracing, this bracing should be removed because, if it is left in place, it may delay the settlement, or subsidence, of the fill, while as settlement occurs, it is quite likely to break these braces and cause the bents to move longitudinally with the bridge, an event that must be avoided by all means.

It is not so necessary to remove the tower and sway bracing, but for the same reason it is well to do so. Piles offer little resistance to the settlement and compacting of the fill, and the sooner this is completed the better it will be. The bracing should not be removed, however, until the fill reaches its level.

Braces Add Safety

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

A trestle is seldom filled until the service life of the timber has substantially expired. In almost every case within my experience, at the time of filling some of the original timber had already failed and had been replaced. In many of these cases, because the structures had been scheduled for filling at the end of their service life the replacement had been somewhat temporary in character, as for example, by the lagging of posts or the erection of framed bents on pile stubs. While perfectly safe for operation, this weakened the resistance of the bents to longitudinal movement, such as may be induced by the pressure of the filling material as it is placed and settles or is compacted artificially.

Filling material may be placed from nearby borrow pits by means of scrapers or wagons, or by dumping from the track level. In either event, it should be spread in such a way as to bring it up in uniform horizontal layers. It will be better if it is compacted by means of a road roller or heavy tractor as it is placed. This method of placing will minimize the tendency toward horizontal movement as the remainder of the settlement takes place.

Experience has shown that, whichever method of placement is employed, it is necessary to leave the longitudinal and tower braces in place and full-bolted until the fill reaches the point where they will no longer clear teams, tractors, wagons, rollers, or a drag-line if the latter is employed for spreading the material. At this time they should be removed to permit the filling to be placed closely around the posts or piles in the bents of the structure.

I have experienced some serious difficulties in connection with the filling of several high trestles, in which the longitudinal and tower braces were removed before the filling was started. It is quite common for the

new material, especially when it is not compacted as it is placed, to move horizontally as it settles. When this occurs, lagged posts and framed bents are quite likely to be shoved off of their supports or from under the ends of stringers. Even pile bents may be pushed from under the stringers in this way. Movement of this kind may make it necessary to drive pile bents to carry the traffic until sufficient settlement has taken place to permit the removal of the stringers. In no case should the sway bracing be removed, since there is then no way to hold the posts or piles, to prevent them from being shoved out from under the caps.

It will be helpful to place two struts between adjacent piles in the bents, one about 8 ft. above the ground and the other from 4 to 6 ft. below the cap. This is particularly important where gumbo is employed for filling, and especially so in trestles ranging from 18 to 30 ft. high. Where gumbo is used for filling it should not be brought higher than about 6 ft. below the rail and loose sandy material should be used for topping. Gumbo shrinks and cracks as it dries out, and if brought to the elevation of the subgrade, water from subsequent rains will enter these cracks, which may result in a further shifting of the bents before the stringers are removed, and later slides or water pockets may develop and cause trouble.

In this connection, it is important that the caps be removed with the stringers. Otherwise it may take years for the fill to settle solidly around the tops of the piles or posts, and water will collect in the cavities under the caps to form the nuclei for water pockets. When the stringers and caps are removed, the filling should be well tamped before ballast is placed. A clamshell bucket makes an ideal instrument for doing this work effectively.

If the surface is crowned to give a pitch both ways from the center of the roadbed, it will afford good drainage and keep water from percolating down along the vertical timbers and thus add to the stability of the fill.

Replacing Failed Stone Arches

Where a failing stone arch is being replaced with a concrete arch having the same clearance dimensions, what is the best method of doing the work? What sequence should be followed in performing the various operations?

Solution May Be Difficult

By M. Hirschthal
Concrete Engineer, Delaware, Lackawanna & Western, Hoboken, N.J.

In most cases, the signs of approaching failure of old stone and brick arches can be observed well in advance of actual failure. For this reason, in the majority of cases, the structures can be saved, or at least the life prolonged for a sufficient number of years to justify the expense, by a lining of concrete, reinforced if this is considered necessary. This is a relatively simple procedure and distinctly economical as compared with complete replacement.

Obviously, the lining will reduce the horizontal clearance by twice the thickness of the jacket. Occasionally and for various reasons, the existing clearances must be maintained, in which event the structure must be replaced. In this case, consideration must be given to the necessity for maintaining traffic over the full width of the arch, that is, on all tracks, or to whether it can be routed over one half (or some smaller fraction) of the arch during reconstruction.

If the first requirement must be met, the problem may present a complication of many difficulties, varying in proportion to the span of the structure. For small structures or those in shallow fills, piles can be driven back of each abutment and the span carried on temporary stringers, after which the sequence is to remove the old structure and construct the new one.

If the span is too long for ordinary stringers, either of two alternative measures may be adopted. If the barrel of the arch is not too wide, transverse floor beams may be inserted under the track, of sufficient length to project beyond the end faces of the arch, where pile bents have been driven to support them. They will then carry the live and dead loads independent of the falsework for the arch. The stone can then be removed and the new structure completed.

The alternative will be to erect falsework of sufficient strength to carry the live load with reduced impact allowance, since a slow order will be necessary during construction, in addition to the dead load. Provision must also be made for running sheathing horizontally across the barrel above the line of the extrados of the new arch barrel, so as to retain the filling material which carries the roadbed, removing the stones but retaining individual sections as vertical or normal braces at intervals. In this way the new arch can be constructed in sections of convenient length.

If traffic can be diverted from one or more tracks at a time the procedure will be greatly simplified, especially if the fill is relatively shallow. In this case, only the falsework necessary to carry the dead load of the super-structure of the arch is needed, and after the old arch is removed the new one can then be followed progressively for the remaining sections. The use of high-early-strength cement will accelerate the curing and result in earlier completion of the work. In all of these methods, placement of the concrete by pumping should prove more satisfactory than the methods of deposition that are ordinarily used.

Open Trench Best Method

By A. R. Ketterson
Assistant Engineer of Bridges, Canadian Pacific, Montreal, Que.

Obviously, the details of the procedure to be followed will depend in large measure on the local conditions, including the volume and character of the material in the fill and the volume and depth of the water passing through the opening. For the average case, the open trench provides the most suitable and economical means of reconstruction, since it involves no complicated planning or operations.

In this method the first step is to construct a temporary pile trestle to carry traffic, with a center span of sufficient length for the piles to clear the footings. This span may be of steel resting on pile bents, but the flanking spans to care for the slope of the excavation are usually wooden stringers. Since the existing arch masonry is of stone, one may readily infer that the fill has been in place long enough to have become well consolidated, and that for a limited time the excavated slope will stand steeper than the usual ratio of 1 to 1½.

Sometimes when the arch is in a shallow fill, one can excavate a trench with vertical sides, extending from footing to subgrade, and having a width equal to the distance between the bents supporting the span which straddles the arch. In this case, the sides of the trench can be shored by means of horizontal planks spiked to the bents as the excavation pro-

gresses, using struts across to the opposite bent where deemed advisable. Even in deep fills the width of the excavation can sometimes be reduced by making the trench vertical at the base and starting the slope at some point above the elevation of the natural ground.

Having completed the trestle and removed sufficient of the overlying fill to expose the back of the masonry, the arch may be demolished in short sections. The forms for each section can then be erected at once and the concrete deposited before the next section is demolished. Following this sequence of removing only one short section of the arch at a time and immediately completing the corresponding length of the new arch, will reduce the chance of causing an extensive disturbance to the embankment, while it will also reduce to the minimum the strutting necessary to hold the forms for the haunching in place against the pressure of the earth. This latter observation refers to that part of the arch which extends beyond the limits of the trestle, since within the limits of the outer piles of the bents, the shoring spiked to the piles and strutted properly will act as a retaining wall for the earth.

Destroying Weeds at Stations

What is the best method of destroying weeds on station tracks, yard leads and yard and industrial tracks? What are the advantages?

Prefers the Weed Burner

By G. O. Broussard
Roadmaster, Southern Pacific, Morgan City, La.

I prefer to use a weed burner to destroy weeds on station tracks, yard leads and yard and industrial tracks. Burning is an economical method of weed destruction and can be done at the time the equipment goes over the line, generally with no serious delay to the weed-destroying operation on the main tracks. Since the conditions at these locations generally favor weed growth, the burning should be done periodically and at such times as will prevent seeding. Aside from the primary purpose of destroying the weeds, the advantages are that track inspection and maintenance are facilitated in the vicinity. The ballast is kept cleaner and drainage, sometimes not too good on these tracks, is substantially improved.

Uses Chemical Destroyers

By L. L. Adams
Division Engineer, Louisville & Nashville, Evansville, Ind.

Several methods are available for destroying weeds on station, yard and industrial tracks, including spraying and dusting with chemicals, burning with steam or flame and the old methods of pulling by hand and cutting with shovels. If either steam or flame is used as the destroying agent, only the tops of the plants are affected; the roots remain and it is only a short time before the growth is restored. On the other hand, if the weeds are pulled or treated with chemicals, the roots are destroyed and the crop can be restored only through seeding.

Owing to the high cost of hand labor, the most economical method of complete weed destruction in the locations under discussion is that of chemical application. The chemical not only kills the growth at the time of application, but its continued use tends to sterilize the soil and ballast to such an extent that weed and grass seed no longer continue to germinate in them.

The chemical can be applied as a powder by dusting or as a liquid by spraying but I have been able to obtain much better results from spraying than from use of the dry form. I am convinced that the best and most economical method of destroying weeds in the locations mentioned is by the persistent and proper use of the right chemical.

Finds Rock Salt Effective

By G. S. Soutas
Section Foreman, Denver & Rio Grande Western, Richfield, Utah

For more than 25 years I have been using rock salt for the purpose of keeping weeds down on station tracks. My method is to spread the finer sizes—ground salt is best if it can be obtained—to a depth of about ¼ in. over the area to be protected against vegetation. Since a single application will be effective for a period of from five to eight years, depending on the amount of rainfall, this is the easiest and cheapest method of which I know for keeping these tracks clear of weeds and plant growths of all kinds.

What Way to Distribute Ties?

What are the relative advantages of distributing ties by work train and by motor cars and trailers? What considerations are involved?

Advantages Not Relative

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

In my experience it is not practicable to state relative advantages for the two methods of tie distribution mentioned in the question, since the conditions under which each should be employed are entirely different. If a large number of ties are to be unloaded and an ample force is available, the work train is not only more practicable, but the work can be done more quickly at a lower unit cost. On the other hand, where only one or two cars are required on a section, it will be more economical to set the cars out at the nearest stations and truck the ties with a motor car and trailer.

When unloading cars on sidings, the men are not rushed to clear trains, for which reason personal injuries are less likely to occur. Again, when unloading from a trailer, every tie can be placed opposite the point of use ready for insertion in the track, thus saving the labor of straightening up and placing the ties, as is necessary, after they have been unloaded from a work train.

Several Factors Involved

By C. R. Wright
District Engineer, New York, Chicago & St. Louis, Frankfort, Ind.

Several factors must be given consideration before making a decision as to which method to employ for distributing crossties on outlying sections. Tie distribution in a large terminal presents an entirely different problem, which will not be discussed here.

If the ties are being shipped to a

division in large number, the prompt release of the cars becomes important, and the distribution should be made by work train. If the individual shipments are small and the arrivals somewhat irregular, the distribution can best be made either from a regular freight train, preferably a local freight, or by motor car. The choice should be based largely on the number of ties to be distributed to the mile, the length of the haul and the amount of labor available.

It goes without saying that a careful inspection and record of the ties required on each mile of track must be made before the new ties are distributed. Where the proper information is available, the ties can be unloaded from a work train almost exactly at the point where they are to go into the track. If this is done, rehandling and trucking after they are unloaded will be eliminated.

Conditions vary between divisions of a railway, and sometimes on different sections of a single division. For this reason, it is always necessary to adapt maintenance work in general, and particularly such details as the distribution of ties, to the local conditions. The method employed for distributing ties should be, therefore, one that will require the minimum amount of labor and expense to place the ties exactly where they are to be used in the track.

Favors Work Train

By G. O. Broussard
Roadmaster, Southern Pacific
Morgan City, La.

The method to be followed will depend in large measure on the size of the gang and the number of ties to be distributed. If the gang is of sufficient size to warrant the use of a work train, this is the quickest and most economical method. If the gang is small, the expense of the work train may make the unit cost for unloading prohibitive, in which event the motor car and trailer may be more economical. If only a few ties are to be distributed, the motor car is generally more practicable.

Susceptible of Two Answers

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

It is possible to answer this question in two ways, since both work trains and motor cars have their place in the distribution of ties. A motor car and trailer loaded with ties have no place on a busy high-speed line, particularly if the ties are to be hauled a considerable distance. On such a line, a section foreman, no matter how capable or careful he may be, should not be required to watch for trains and at the same time oversee the handling and distribution of the ties, for his attention is certain to be diverted from one or the other too much of the time.

On the other hand, if a work train is employed, the conductor will look out for trains and the foreman can give his undivided attention to unloading and distributing the ties. When ties are unloaded from a work train, they can be placed exactly at the point of use without intermediate handling. Ties should always be shipped in sufficient number to make their distribution by work train both practicable and economical.

There are places where it is not practicable to distribute ties in advance of use, in which case the motor car and trailer afford the best means of making the delivery. Again, during the winter, the forces on many branch lines are so reduced that if ties are received, there is no alternative to unloading and piling them on the station grounds, in which event distribution can best be made by motor car and trailer later when more men are available.

Other conditions might be mentioned where, from the standpoint of practicability, the motor car affords the best means of distributing ties, but a work train, including the use of local freights, should be employed wherever conditions permit this to be done. To distribute ties by trailer requires that they be unloaded, handled to piles, or to clear the unloading track, and then loaded on and unloaded from the trailer, and each handling adds to the final cost of the tie, as well as reduces the productive labor of the gang.

Determining Location for Wells

When necessary to obtain water from underground sources, how does one determine where to locate the well and its probable capacity?

Very Largely a Guess

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Except on new lines where the water stations can be located at those places where water is most readily available, there is usually little choice for the location of a well. On existing lines, wells must be located approximately in the vicinity of the established pumping facilities to avoid the construction of long pipe lines or the employment of additional help for operation.

Operating requirements govern the spacing of water stations, with the result that these facilities frequently are located at isolated places in the country, sometimes a mile or more from the nearest habitation. For this reason, the obtaining of a satisfactory supply of water from underground sources will be largely a matter of guess work.

In such cases, a search through federal or state geological or water-resource reports may give some information regarding the probability of securing an adequate supply at a reasonable depth. In some sections of the country, certain water-bearing sandstone formations cover extensive areas. Knowledge concerning the depth of these strata at distant places will often enable one to approximate their depth at the location of the proposed wells. In other places, the water may be found in glacial drift, and here the depth and volume of the supply available may be a matter of much uncertainty.

If there are existing wells in the vicinity or, say, within a radius of a mile, of the proposed location, a careful survey of the more important drilled holes will usually give information with respect to depth, formations penetrated, volume of flow and quality of the water obtained. From these data a reasonable prediction can be made of what may be expected from the new wells. Even when an extensive and careful investigation of this kind shows favorable data, it is not always conclusive, and many wells have been drilled where the best estimates proved to be wrong. For this reason, except where the underground formations are known to contain a large volume of water at about a uniform depth, the drilling of wells is at best a gamble.

Almost every one engaged in drilling wells has heard of the divining rod used by the so-called water witches, who will offer to show one exactly where to place the drill hole and how deep it will be necessary to go to reach an abundant supply of water. But all of their art fails when a demand is made for a stipulated

quantity of water of a given quality and free from fine sand. These water witches derive their reputation from the fact that they are right a large part of the time because nature has provided a bountiful supply of underground water, which can generally be reached if we can afford to go to the depth necessary to tap it.

A municipality may find it feasible to locate its deep wells at rather widely separated points about the city, but a railway does not enjoy the advantage of such flexibility since it is usually limited to a single location at which a well must be developed to produce the required water.

Get All Available Data

By R. L. Holmes
Engineer Water Supply, Texas & Pacific, Dallas, Texas

When preparing to develop a well or a system of wells, the first move should be to contact all of the well drillers who are familiar with the locality in which the wells are to be driven. The information obtained from them can then be compared with the United States Geological Survey report, if one is available covering the section in which the proposed site of the wells is located.

From all of the information thus collected, one can make a fairly good guess, and it will be but little more than that, as to what the possibilities are. Although the information thus obtained may be reliable with respect to known water-bearing strata, there can be no set rule regarding the location of the well, because of such strata are known to contain "pinches" or extremely hard and largely impermeable formations. If one is so unfortunate as to strike either one of these, the well may be a poor producer. For these reasons, one can only make a guess as to the probable production of any well in advance of the drilling even though considerable thought may be given to the question.

Gaging First or Bolting?

When laying rail, should the gaging be done before or after the bolts are tightened? Why?

Gaging Last Avoids Lips

By H. E. Herrington
Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

It has been my experience that unless the joint bars are applied and at least the middle two bolts are tightened before the track is gaged, there is danger of leaving a lip between the adjacent rail ends. Gaging is usually done at the quarters, centers and joints and the intermediate spikes are driven later. If a spiker sets an intermediate spike slanting, it may draw the rail enough to cause a lip at the joint unless the bolts are well tightened. It would then be necessary to withdraw this spike, and probably others, in order to restore the rail ends to the same relative alinement. If the bolts are in full tension, it is not possible for this movement to occur.

Lay Line Side First

By J. J. Desmond
Division Engineer, Illinois Central, Chicago

When laying rail, the line side should be laid first, the bolts tightened and the spiking done. Then the gage side can be laid, and again the next operation should be the tightening of the bolts before the track is gaged. The reason for tightening the bolts first is to insure that the rail ends will be in the same alinement and thus eliminate the offset, or "lip," between adjacent rails that may result if this sequence is not followed. It is also difficult to hold the expansion gap uniform unless the bolts are tightened in advance of the spiking operation.

When laying rail on curves, it is imperative that the bolts be tightened first, since the rail cannot otherwise be made to conform to the arc of the curve. It is difficult to obtain perfect seating of the joint bars when they are first bolted, for which reason a second tightening is necessary a few days after the track has been restored to operation.

Rule Should Be Rigid

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Under no circumstances should rail be gaged before the bolts are tightened, and the rule on this point should be inflexible. If four-hole joints are applied, the full complement of bolts should be used and drawn up as tight as the means at hand permit. With six-hole joints, the two end and two middle bolts should be inserted and tightened in the same way. Then after the gaging is completed, but before trains are allowed to pass, the intermediate bolts can be applied. Failure to follow this sequence, or to draw the bolts as tight as practicable, will result in kinked joints. I have never seen a case of gaging ahead of the bolt tightening that did not leave some irregular gage around the joints.

Tighten Bolts First

By W. E. Tillett
Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

Proper relative alinement of the adjacent rail ends is difficult, if not impossible, to obtain, unless joints are applied and bolts are tightened ahead of the gaging, while kinking at the joints is equally difficult to avoid.

The proper application of the joint bars is also important. The center two bolts should first be drawn tight and the bars tapped on the base to bring them into position, with full contact on the fishing surfaces, after which the remaining bolts can be tightened. The gaging can then proceed without danger of a lip forming at the joint or of the development of line-bent rails.

Makes Little Difference

By Robert White
Grand Trunk Western, Brayton Plains, Mich.

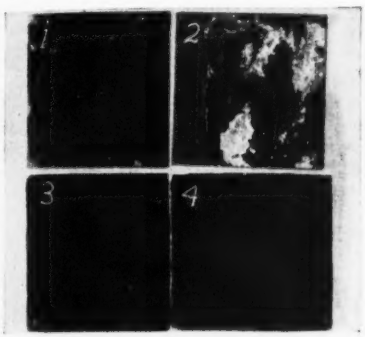
This seems to be a matter of foreman's choice, since so far as maintenance is concerned, either may be done first, depending on which will result in the least loss of time and expense. If the new rail has a wider base than that being released, the gagers generally follow close behind the laying. If they must wait on the bolting gang, they will soon fall far behind and will later require help to permit them to catch up with the main operation.

Again, if gaging is done first, it is less difficult to get the joint bars in place, but considerable care is necessary to insure that the expansion shims remain in place. One objection to this procedure is that the joints cannot be spiked until the bars are applied and the bolts tightened. If the new rail has the same base as the old and only the inside spikes are removed, I fail to see where it makes any difference whether the gaging or bolting is done first.

New and Improved Devices

New Protection Against Corrosion

GREATLY improved protection for structural members exposed to corrosive gases and liquids is claimed for a new process involving the application of a covering known as Asphaltic-Guncrete. As the name indicates, this material is a combination of bituminous compounds with a granular mineral aggregate applied pneumatically by means of equipment similar to the cement gun.



A Comparative Test

Steel plate, 16-gage 10 in. square, hung for 14 months in a locomotive smoke jack coated as follows: No. 1, bituminous paint—No. 2, linseed oil and pigment paint—No. 3, Asphaltic Guncrete—No. 4, same as No. 3, hung horizontally 30 in. above passing locomotive for 30 days

The protection is applied to a thickness of approximately one-sixteenth of an inch in two or more coats. The first coat is designated as "penetrative, adhesive and elastic," while the subsequent coats, due to the granular content, provide resistance to mechanical injury.

Asphaltic-Guncrete is advocated as a protection for all manner of structures subjected to extreme smoke exposures, for wet tunnels, parts of bridges exposed to brine drippings and other bridges and buildings of metal or masonry subject to disintegration by reason of the presence of moisture or other corrosive agencies.

Exposure tests of steel plates protected with Asphaltic-Guncrete in train-shed smoke slots, roundhouse smoke jacks, and other locations are said to have shown high resistance to both corrosive gases and cinder blasts, and an abrasion test in which a 16-gage plate 12 in. square was driven into frozen gravel resulted in slight injury to the coating. The process has been applied to the faces of smoke slots, the walls and ceilings of smoke-exhaust chambers and to the outside walls of concrete grain elevator silos, this work being done by the Cement Gun Construction Company, Chicago, licensees from the Asphaltic Guncrete Company, Chicago, which owns patents covering the process.

Develops New Combination Goggle

A NEW style of goggle, which combines the protective qualities of two separate types of goggles has been placed on the market by Willson Products, Inc., Reading, Pa. This new goggle, which is known as Style DC50, is designed for use on jobs where an excessive light condition exists part of the time in addition to flying particles.

Above—The New Willson Chip-Weld Goggle With the Weld Lenses in the Lowered Position. Below—The Goggle with the Weld Lenses in a Raised Position

In this goggle, protection against the impact of flying particles is furnished by 50-mm. clear "supertough" lenses, while protection against dangerous light rays is provided by 50-mm. weld lenses which are carried in frames hinged at the top so that the weld lenses may be raised to a horizontal position above the eyes when not in use. The weld lenses are of the Willson-Weld type, which filters out the injurious rays from intense light such as is encountered in welding and similar work. Thus, in chipping or grinding operations the hinged lenses are raised and when welding work is to be performed they are turned downward over the inner lenses.

Other features of design include ample ventilation through indirect ports, an adjustable leather nose bridge, elastic headbanks and molded black composition cups that are shaped to fit the curves of the face.

New Book

Bridge and Building Proceedings

PROCEEDINGS of the American Railway Bridge and Building Association for 1934, 202 pages, 6 in. by 9 in. Bound in cloth. Published by the Association, 319 North Waller avenue, Chicago. Price $2.

Owing to the fact that the association held no conventions in 1931, 1932 and 1933, this is the first volume of the Proceedings to appear since the report for 1930. The subject-matter is of the same general character as that of previous volumes, and includes the reports of 10 committees, a paper by C. C. Westfall, engineer of bridges of the Illinois Central, on the power tools used in the construction of the Bonnet Carre spillway structures, and several addresses. The committee reports cover the following subjects: Maintenance of Ballast Deck Trestles, Guard Rails on Bridges, Brush and Spray Painting, Specialized vs. General Gangs, Relative Economy of Various Culvert Materials, High-Early-Strength Concrete, Safety Measures, Lessons from the Depression, Electric Pumping Equipment, and Programming Work.

News of the Month . . .

Nine Trackmen Lose Lives on Southern Pacific

Nine trackmen were killed and four were injured, one seriously, on the Southern Pacific on April 8 when the motor car on which they were riding was struck by a work train. The accident took place at a point near Roseville, Cal., where the men had been engaged in the repair of tracks damaged by flood waters from the Sacramento river.

Additional Rail Orders

Several large orders for rails and fastenings have been placed during April. The largest order, 25,000 tons, was placed by the Chicago & North Western, 18,000 tons going to the Illinois Steel Company and 7,000 tons to the Inland Steel Company. Orders for the necessary fittings to go with this rail have been divided among 10 different companies. The Union Pacific has placed orders for 19,500 tons of rails as follows: Illinois Steel Company, 8,580 tons; Inland Steel Company, 2,340 tons; and Colorado Fuel & Iron Company, 8,580 tons. The Chicago Great Western has ordered 5,000 tons of rail, 4,000 tons from the Illinois Steel Company and 1,000 tons from the Inland Steel Company. The Kansas City Southern has ordered 2,000 tons of rail from the Illinois Steel Company, while the Western Pacific has placed an order for 3,000 tons with the Colorado Fuel & Iron Co.

The Erie has obtained a loan of $1,000,000 from the Public Works administration to finance the purchase of 15,000 tons of rail and the necessary fastenings.

Pelley Proposes Three-Point Railroad Program

Given a free rein in working out their problems, equal opportunities with other methods of transport and a return of normal business conditions, "the railroads again will give a good account of themselves from the standpoint of earnings and the effect on general business through their increased purchasing power," said John J. Pelley, president of the Association of American Railroads, in an address before the New York State Chamber of Commerce at New York, on April 4. Mr. Pelley proposed a "three-point" program as follows:

1. Withdraw the subsidies from other forms of transportation and regulate them on a basis comparable with the railroads.
2. Prevent the enactment of any legislation that increases the cost of railroad legislation.
3. Discontinue the co-ordinator law and give the Association of American Railroads an opportunity to do for the rail carriers what can be done within the industry itself.

Accidents at Grade Crossings Show Increase

During 1934, 1,554 persons lost their lives in highway-railroad grade crossing accidents, an increase of 43 as compared with 1933, in which year fewer persons lost their lives in such accidents than in any similar period since 1916, according to reports received by the Safety Section of the Association of American Railroads. This is the first increase in fatalities due to such accidents that has been reported since 1928. Persons injured in highway-railroad grade crossing accidents in 1934 totaled 4,300, an increase of 603 as compared with the number injured in 1933. During 1934 there were 4,128 accidents at such crossings, an increase of 892 as compared with the number that took place in 1933.

Railroads Launch Advertising Campaign

A comprehensive passenger-service advertising campaign designed to win lost passenger traffic back to the railroads and to create new business was launched by the Western railroads on April 15. This program, which will be carried out through the medium of newspaper and magazine advertising, will feature air-conditioning as the main theme, with further emphasis on economy of travel in the West, where the basic rates have been reduced and the sleeping car surcharges eliminated. The newspaper campaign will involve the use of 369 newspapers in 268 cities, mostly in the West, while advertising will also be placed in four weekly magazines, including the Saturday Evening Post, Colliers, the Literary Digest and Time. The list of business publications in which advertising will be carried includes Business Week, Forbes, Nation's Business, Traffic World and Railway Age.

Senate Passes Motor Carrier Bill

A bill providing for the regulation of motor carriers operating on the highways in interstate commerce was passed by the Senate on April 16 and was then referred to the Committee on Interstate and Foreign Commerce of the House of Representatives, which was expected to act on it at an early date. This bill, which comprises an important phase of the program of transportation legislation drawn up by Joseph B. Eastman, co-ordinator of transportation, failed to develop the expected amount of opposition in the senate and was passed after only a short debate. It places common and contract carriers on the highways under the jurisdiction of the Interstate Commerce Commission, and authorizes the commission to establish reasonable requirements with respect to uniform systems of accounts, records and reports, preservation of records, qualifications and maximum hours of service of employees, and safety of operation and equipment. The bill also gives the commission power to establish certain requirements concerning private motor carriers.

Temporary Rate Increases Permitted

Temporary increases in freight rates which it is estimated may increase railroad revenues about $85,000,000 annually were authorized by the Interstate Commerce Commission in a decision made public on March 30. This decision was the outcome of an application filed by the railroads on August 27, 1934, for rate advances which it was estimated would add $170,000,000 to their annual revenues. The rate advances were requested by the roads as a means of partially offsetting increases in wages and in prices of materials and supplies of about $293,000,000.

The emergency increases or surcharges allowed went into effect on April 18 and will expire on June 30, 1936. While they apply to a large portion of the railroads' traffic there are many exceptions, notably grain, grain products, cotton, citrus fruits, cattle, sheep, hogs and lumber. While the railroads had proposed increases of generally 10 per cent of the present rates, the increases permitted amount generally to 7 per cent although many of them are even smaller than this.

Rail Revenues Larger But Net Income Declines

For February the Class I railroads of the United States had a net railway operating income of $25,719,919, which was at the annual rate of return of 1.63 per cent on their property investment, as compared with a net of $29,420,772, or 1.85 per cent, in February, 1934, according to figures compiled by the Bureau of Railway Economics. The drop in net income took place despite larger operating revenues which totaled $254,940,047, as compared with $248,457,242, an increase of 2.6 per cent. Operating expenses in February, however, amounted to $200,103,243, as compared with $188,605,786 in the corresponding month of last year, an increase of 6.1 per cent.

During the first two months of the year the Class I railroads had a net railway operating income of $47,047,014, a return of 1.57 per cent as compared with a net railway operating income of $60,479,052, or 2.01 per cent, in the first two months of 1934. Although operating revenues increased from $506,471,757 to $519,155,876, or 2.5 per cent, between these periods, operating expenses increased from $384,472,007 to $413,078,028, or 7.4 per cent.

Association News

The Bridge and Building Association

The proceedings of the convention last October have been sent to members during the month.

The Roadmasters Association

The proceedings of last September's convention have come from the printer and were distributed to the members during the month.

International Railway Maintenance Club

The next meeting of the International Railway Maintenance Club will be held on May 9 at the Royal Conneaught hotel, Hamilton, Ont. Following luncheon at 12:30 E.S.T., the meeting will be addressed by R. B. Steele, transmission engineer of the Canadian National Telegraphs, Canadian National Railroad.

Metropolitan Track Supervisors' Club

The Metropolitan Track Supervisors' Club met at the Hotel McAlpin, New York City on April 25. Following dinner, George Green, of Teleweld, Inc., addressed the club on "The Electric Welding of Trackwork," following which S. G. Ellis, Railroad Accessories Corporation, described in some detail the Raco power track machine. Thirty-five members and guests were in attendance.

American Railway Engineering Association

Four committees met in April, including those on Economics of Railway Labor, at Detroit, Mich., on April 16; Economics of Railway Operation, at Chicago, on April 26; Maintenance of Way Work Equipment, at Chicago, on April 30; and Waterways and Harbors, at Chicago, on the same date. Five meetings have already been scheduled for May, including those of committees on Standardization, at Philadelphia, Pa., on May 6; Water Service, Fire Protection and Sanitation, at Cincinnati, Ohio, on May 7 and 8; Masonry, at Chicago, on May 8 and 9; Buildings, at Buffalo, N.Y., on May 9 and 10; and Iron and Steel Structures, at Chicago, on the same days.

Maintenance of Way Club of Chicago

Eighty-five members and guests attended the sixteenth annual meeting held at the Auditorium hotel, Chicago, on April 17. The subject for the evening was "The Use of Motion Pictures in the Promotion of Standard Practices in Track Work," the presentation consisting largely in the showing of motion pictures of methods employed on the Chesapeake & Ohio in the handling of major track operations. The manner of using these pictures was explained by C. H. R. Howe and H. E. Kirby, cost engineer and assistant cost engineer, respectively.

The following officers were elected: President, V. R. Walling, engineer maintenance of way, Chicago & Western Indiana; First vice-president, E. J. Brown, roadmaster, Chicago, Burlington & Quincy; Second vice-president, W. G. Arn, assistant engineer, Illinois Central; Secretary-treasurer, W. S. Lacher, managing editor, Railway Engineering and Maintenance (re-elected). Directors (serving 2 years), P. F. Muller, roadmaster, Chicago & Western Indiana; E. W. Backes, chief engineer, Standard Equipments Company; and C. E. Morgan, superintendent work equipment & welding, Chicago, Milwaukee, St. Paul & Pacific.

The Railway Tie Association

This organization will hold its seventeenth annual convention at the Hotel Jefferson, St. Louis, Mo., on May 15-16, with an inspection trip of treating plants in the St. Louis area on the forenoon of May 17.

Among the papers which will be presented at that meeting are the following:

Adjusting Percentages of Grades in Tie Purchases to Woods Production—Railroad viewpoint by H. R. Duncan, superintendent timber preservation, C.B. & Q.; Producers' viewpoint by W. P. Arnold, engineer, Century Wood Preserving Co.;

The Arrangement and Maintenance of Assembly and Concentration Yards, by C. H. Hobbs, Hobbs Western Co.;

Trends in Railway Practices as They Affect Tie Life, by Elmer T. Howson, editor, Railway Engineering and Maintenance;

Why, When and Where to Apply Anti-Splitting Irons to Ties in Storage, by R. E. Beegle, Beegle Tie Service Co.

There will be a round table discussion on Non-Adherence of Railroads to Standard Specifications and the Resultant Bad Effects on the Tie Industry. There will also be an address on What the Railway Tie Association Can Do to Aid the Industry. The annual dinner will be held on Thursday evening, May 16.

Expect Second-Quarter Car Loadings to Increase

Freight carloadings in the second quarter of 1935 are expected to be about one-tenth of one per cent above actual loadings in the same quarter of 1934, according to estimates compiled by the 13 Shippers Regional Advisory Boards. On the basis of these estimates, freight carloadings of the 29 principal commodities would be 4,605,737 cars in the second quarter of 1935, compared with actual loadings of 4,603,241 cars of the same commodities in the corresponding period of last year. Eight of the 13 boards estimate that increases will take place in the carloadings in their respective regions during the period while five anticipate decreases.

Personal Mention

General

J. G. Reid, assistant engineer in the construction department of the Canadian Pacific, with headquarters at Prince Albert, Sask., has been appointed assistant superintendent of the Saskatoon division, with the same headquarters.

S. H. Osborne, division engineer on the Union Pacific, with headquarters at Denver, Colo., has been appointed assistant to the executive vice-president of the system with jurisdiction over safety matters, with headquarters at Omaha, Neb. He succeeds **G. H. Warfel,** who has been appointed assistant superintendent at North Platte, Neb.

J. C. White, superintendent of freight transportation of the Eastern region of the Pennsylvania, and formerly a division engineer on this road, has been oppointed superintendent of the Long Island (part of the Pennsylvania), with headquarters at Jamaica, Long Island. Mr. White entered railway service with the Pennsylvania, as a chainman in the division engineer's office at Tyrone, Pa., in June, 1912. He was then advanced through various positions in the engineering department to that of division engineer of the New York division. In January, 1931, Mr. White was appointed superintendent of the Monongahela division at Uniontown, Pa., being transferred in the same year to the St. Louis division. He became superintendent of the Eastern Ohio division at Pittsburgh in September, 1932, and a year later was appointed superintendent of the Philadelphia Terminal division. In November, 1934, he was appointed superintendent of freight transportation of the Pennsylvania's Eastern region at Philadelphia, which position he held until his recent appointment.

J. C. White

Martin W. Clement, vice-president in charge of operation of the Pennsylvania and formerly a division engineer on this road, has been elected president, effective May 1, to succeed General **W. W. Atterbury,** who has resigned his position as president because of ill health but will

remain as a director. Mr. Clement has been connected with the Pennsylvania continuously for 34 years. He was born at Sunbury, Pa., on December 5, 1881, and received his higher education at Trinity college, Hartford, Conn. He entered the service of the Pennsylvania in 1901 as a rodman on the engineering corps, serving in various positions in this department until 1905, when he was appointed assistant supervisor. Five years later he was further advanced to supervisor and in 1914 he was made division engineer. In 1917, Mr. Clement was transferred to the operating department as division superintendent, being appointed superintendent of freight transportation in the following year. In 1919 he was made superintendent of passenger transportation and in 1920, he was made general superintendent. Three years later Mr. Clement was appointed general manager of the Central

Martin W. Clement

region at Pittsburgh, and in 1925 he was appointed assistant vice-president in charge of operation for the system. His election to the vice-presidency in charge of operation came in the following year. His headquarters are at Philadelphia, Pa.

T. C. Herbert, superintendent of the Pittsburgh division of the Pennsylvania, and an engineer by training and experience, has been promoted to general superintendent of the Lake division, with headquarters at Cleveland, Ohio. Mr. Herbert was born at Richmond, Me., on April 30, 1883. He was educated in the public schools of Richmond and was graduated from the University of Maine with the degree of Bachelor of Science in Civil Engineering. He entered the service of the Pennsylvania in December, 1905, as an assistant in the engineering corps, serving in that capacity on several divisions until December, 1915, when he was appointed pilot engineer in the valuation engineer's office. Mr. Herbert was promoted to supervising pilot engineer in June of the following year. In September, 1916, he became assistant division engineer of the Louisville division, later holding similar positions on the St. Louis and the Pittsburgh divisions. In March, 1920, he was further advanced to division engineer of the St. Louis division and in February, 1922, he was transferred to the operating department as superintendent of the Peoria division, later serving in the same capacity on the Schuylkill division, the Atlantic and Camden Terminal divisions and the Monongahela, Panhandle

T. C. Herbert

and Pittsburgh division, being located on the latter division at the time of his recent promotion.

Paul E. Feucht, division engineer of the Ft. Wayne division of the Pennsylvania, with headquarters at Ft. Wayne, Ind., has been promoted to superintendent of the Wilkes-Barre division, with headquarters at Sunbury, Pa. Mr. Feucht was born at Indianapolis, Ind., on January 4, 1900. He received his early education in that city and completed his college education at Purdue University. He entered the service of the Pennsylvania as an assistant on the engineering corps of the Louisville division. In May, 1925, he was transferred to the Indianapolis division, where he remained until January, 1927, when he was promoted to assistant track supervisor on the Philadelphia Terminal division. Mr. Feucht was transferred to

Paul E. Feucht

Tyrone, Pa., in September, 1928, being promoted to supervisor at Norristown, Pa,. in January, 1929. A year later he returned to Tyrone as a main line supervisor. For a few months in the spring of 1933, he was relieved of his track work and assigned to special duty in the motor service. Upon the completion of this assignment, he returned to Tyrone in July, 1933, and was promoted to division engineer of the Renovo division. In October, 1934, he was transferred to the Fort Wayne division, where he remained until his recent promotion.

Engineering

C. W. Pitts, an assistant engineer on the Union Pacific, has been appointed division engineer at Denver, Colo., succeeding **S. H. Osborne,** who has been appointed assistant to the executive vice-president as noted elsewhere in these columns.

L. W. Althof, roadmaster on the Oregon Short Line at Dillon, Mont., has been appointed division engineer on the Oregon-Washington Railroad & Navigation Co., with headquarters at Portland, Ore., succeeding **H. A. Roberts,** whose death is noted elsewhere in these columns. Both of these roads are units of the Union Pacific System.

W. H. Penfield, engineer maintenance of way of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Chicago, has been appointed chief engineer, succeeding **C. F. Loweth,** who at his own request has been relieved of the responsi-

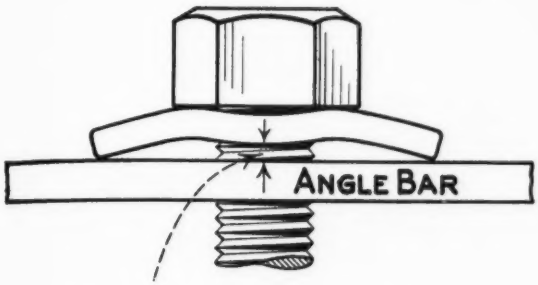
W. H. Penfield

bilities of this position and has been appointed consulting engineer with duties as assigned. Mr. Penfield will continue to have supervision over maintenance of way, including signal and telegraph facilities, and the position of engineer maintenance of way has been abolished. **R. J. Middleton,** assistant chief engineer, has been given direct supervision over engineering work. **C. T. Jackson,** assistant engineer maintenance of way, has had his title changed to assistant to chief engineer, and **William Shea,** assistant engineer maintenance of way, has had his title changed to superintendent track maintenance. All these officers will continue to have headquarters at Chicago. The appointments became effective on May 1.

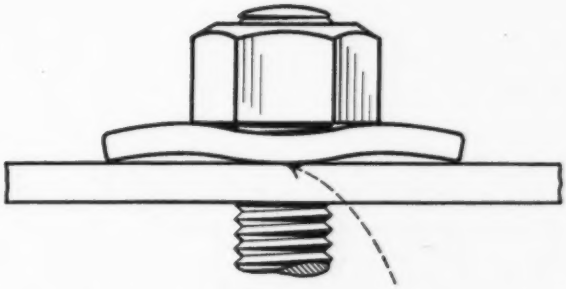
Mr. Penfield was born in 1874, at Foxburg, Pa., and first entered railway service with the Buffalo, Rochester & Pittsburgh as a member of a surveying party in Clearfield county, Pa. He was advanced through various positions in the engineering department to that of resident engineer, holding this position until

VERONA TRIFLEX SPRING

The Only Spring Washer Providing Calibration of Bolt Tension—This is the Most Important Development In Track Fastenings In Years



START (BOLT TENSION ZERO)
Notice the clearance of Triflex Spring before wrenching



FINISH (PREDETERMINED TENSION)
Center of Triflex Spring touches angle bar after wrenching

The design of the Verona Triflex Spring provides a clearance between the center of the spring and the face of the angle bar before the bolt is tightened, as shown in the drawing at left. Approximately one complete turn of the nut brings the center of the spring in contact with the face of the angle bar, resulting in a uniform, predetermined tension.

Verona Triflex Spring is the only device of its kind geared high enough to provide sufficient bolt tension without going flat—and the only one that establishes equal and proper tension in all bolts.

Spring Reaction 100% Greater Than A. R. E. A. Specifications

Triflex Spring Lengthens Life of Bolts, Rails and Rail Joints

SINCE 1873

WOODINGS—VERONA
TOOL WORKS VERONA, PA.

SINCE 1873

August 1899, when he went with the Milwaukee as resident engineer, later serving as locating engineer. From March, 1902, until December, 1905, Mr. Penfield served as a locating engineer for the Western Pacific in California, then returning to the Milwaukee where he was engaged on the construction of the Puget Sound lines of this company until June, 1911, when he was promoted to assistant chief engineer at Chicago. On February 1, 1913, Mr. Penfield was made assistant to vice-president and on November 1, 1917, he was appointed engineer of track maintenance. On December 1, 1920, he was given the title of engineer maintenance of way.

Mr. Loweth was born on March 3, 1857, at Cleveland, Ohio, and obtained his higher education at Oberlin college, Oberlin, Ohio. He obtained his first railway experience in 1876, as a rodman on surveys for the Cleveland, Lorain &

C. F. Loweth

Wheeling (now part of the Baltimore & Ohio). Subsequently he served consecutively as a draftsman on the Atchison, Topeka & Santa Fe; as assistant chief engineer of the Des Moines & Northwestern (now part of the Milwaukee); as consulting engineer on bridge construction for the Northern Pacific; as consulting engineer successively for the Minneapolis & St. Louis, the Minneapolis, St. Paul & Sault Ste Marie, and the St. Paul & Duluth (now part of the Northern Pacific); as engineer of the St. Paul Union Depot Company; and as chief engineer of the South St. Paul Belt Railway. In April, 1901, Mr. Loweth was appointed engineer and superintendent of Bridges and buildings of the Milwaukee, with headquarters at Chicago, with jurisdiction also over the Puget Sound lines of the Milwaukee beginning in 1906. In 1911 Mr. Loweth was made chief engineer of the Milwaukee, which position he held continuously until his recent appointment as consulting engineer. From 1911 to 1913, he also acted as consulting engineer for the Puget Sound lines. Mr. Loweth is a past president of the American Society of Civil Engineers (1923) and of the Western Society of Engineers (1908). He has also served as treasurer and two terms as a director of the American Railway Engineering Association, and has been active in the affairs of numerous other technical societies.

Track

M. S. Smith, supervisor on the Pennsylvania, with headquarters at Shire Oaks, Pa., has been transferred to Williamsport, Pa., to succeed **C. R. Bergman** who has been transferred to Aspinwall, Pa.

T. McMahon, formerly a roadmaster on the Chicago, Milwaukee, St. Paul & Pacific, has been reappointed to that position, with headquarters at Madison, Wis., succeeding **W. E. Palmer,** acting roadmaster, who has been assigned to other duties.

A. E. Sharpe, assistant engineer in the construction department of the Canadian Pacific, at North Battleford, Sask., has been appointed to the newly-created position of roadmaster at the same point. The position of assistant engineer at North Battleford has been abolished.

H. M. Long, assistant engineer on the Kansas-St. Louis division of the Chicago, Rock Island & Pacific, with headquarters at Kansas City, Mo., has been appointed roadmaster at Dalhart, Tex., succeeding **M. B. McAdams,** who has been granted a leave of absence.

James E. Crawford, whose appointment as roadmaster on the Chicago, Rock Island & Pacific, with headquarters at El Dorado, Ark., was noted in the April issue, was born on December 20, 1879, in Scotland county, Mo. He entered railway service on June 15, 1900, as a trackman on the Chicago, Burlington & Quincy, where he was promoted to track foreman in August, 1901. Mr. Crawford served in this capacity at various points on the Burlington until March 10, 1914, when he was appointed yard foreman on the Rock Island at Pratt, Kan. He served in this position and as extra gang foreman until December 20, 1921, when he was promoted to roadmaster, with headquarters at Amarillo, Tex., later serving in the same capacity at Pratt, Dalhart, Tex., and Manhattan, Kan. On January 1, 1933, he was made a track inspector at Manhattan, being again appointed roadmaster at Amarillo on March 1, 1933. On May 1 of the same year Mr. Crawford was again appointed track inspector which position he held until January 1, 1935, when he was appointed acting roadmaster on the Arkansas-Louisiana division, holding this position until his recent appointment as roadmaster, which was effective on March 2.

Special

J. L. Huron, who has been located in the division engineer's office of the New York division of the Pennsylvania, with headquarters at Jersey City, has been appointed machinery inspector on the New York zone, with headquarters at New York, succeeding **J. A. Nash,** whose death is noted elsewhere in these columns.

Obituary

Elliott F. Wise, who retired in 1904 as supervisor of bridges and buildings of the Iowa division of the Illinois Central, with headquarters at Waterloo, Iowa, died on April 19 at his home at Waterloo, at the age of 93. Mr. Wise was born on June 14, 1841, at Fredericktown, Pa. He worked as a ship carpenter from 1863 until 1868, except for a period of three years during which he served as a cavalryman in the Union Army during the Civil war. Mr. Wise first entered the service of the Illinois Central in 1868, as a bridge carpenter at Dixon, Ill. In the following year he was made supervisor of bridges on the Iowa division, at Iowa Falls, Iowa, later being given supervision also over building matters. In 1879 Mr. Wise's headquarters were moved to Waterloo, where he remained until his retirement on June 1, 1904.

John V. Hanna, chief engineer of the Kansas City Terminal, Kansas City, Mo., died suddenly of heart failure on Tuesday, April 30.

J. A. Nash, machinery inspector on the New York zone of the Pennsylvania, with headquarters at New York, died at his home in Trenton, N. J., on March 19.

H. A. Roberts, division engineer on the Oregon-Washington Railroad & Navigation Co. (a unit of the Union Pacific System) at Portland, Ore., died suddenly at that point on April 6.

W. E. Herald, assistant supervisor on the Electric division of the New York Central, with headquarters at Spuyten Duyvil, N. Y., died on April 10 at his home in Yonkers, N. Y.

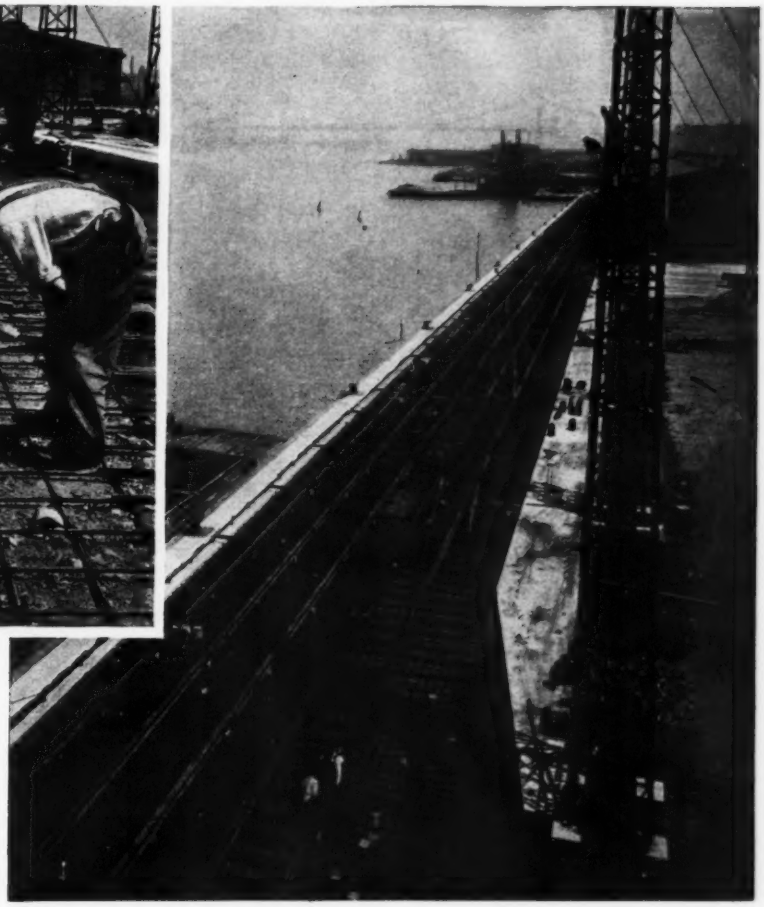
Developments in High Speed Service

Three important developments in the realm of high-speed transportation by rail were the subjects of considerable public interest during the past month. Notable among these was the placing in service on April 21 of the Chicago, Burlington & Quincy's new twin Zephyrs between Chicago and the Twin Cities on a schedule of 6½ hrs., or 390 min., for the 431 miles. One of these two new three-car articulated, stainless-steel, Diesel-electric trains will leave Chicago at 2 p.m. every day while the South-bound train will leave Minneapolis, Minn., at 12 noon and St. Paul at 12:30 p.m.

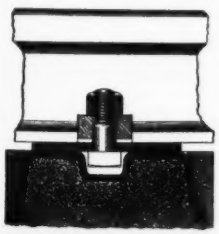
Another development involving high-speed trains was the reduction of the running time of the Chicago & North Western's high-speed steam train between Chicago and the Twin Cities, known as the "400," from 7 hrs. to 6½ hrs., thus placing it on a schedule of 390 min. for the 408.6 miles. This change in schedule was made on April 28.

A third development was the announcement by the Chicago, Milwaukee, St. Paul & Pacific that, between May 15 and 30, it will place its new "speed-train" in daily round-trip service between Chicago and the Twin Cities on a schedule of 6½ hrs. for the 410 miles. This train will be drawn by the first newly-built scientifically streamlined steam locomotive to be especially designed and built for high-speed passenger service. All equipment in this train will be "speed-lined" to reduce air resistance.

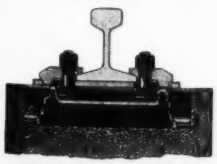
No Anchor Bolts to Install



with the Keystone Rail Anchorage



Cross-section of Keystone Rail Anchorage. Note that the anchorage is firmly held in position by the wedging action of the legs in the concrete.



Side view of Keystone Rail Anchorage.

The Keystone Rail Anchorage provides a secure and easily installed anchorage for rails at ash pits, repair pits, crane runways on piers or in other locations where concrete is used.

Fewer concrete forms are required. No drilling of the concrete is necessary. The tedious and laborious task of lining up anchor bolts is avoided. The cost of laying track with Keystone Rail Anchorages is substantially less than when anchor bolts are used. It is necessary only to fasten them to the rail, align and level the rail, and pour the concrete around the anchorages.

The Keystone Rail Anchorage is made of rust-resisting copper-bearing steel. It is supplied fully equipped with tie plates welded on, heavy rolled-steel rail clips, bolts and unit lock nuts. A ¼-in. difference in the length of the clips permits a ½-in. gage adjustment to take up rail wear.

This anchorage is made in two sizes, No. 17 for use with rails of 100 lbs. and over, and No. 9 for use with rails up to 100 lbs.

Both are made in lengths of from 15 to 24 in.

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

Supply Trade News

General

The Westinghouse Electric & Manufacturing Company has combined its arc welding manufacturing and technical facilities with those of the **Hollup Corporation Sales Service,** Chicago. Hollup, as exclusive distributor of Westinghouse welding equipment, excepting the Back Bay region of the San Francisco district, has distributing facilities in 19 of the principal cities of the United States and at Toronto and Montreal in Canada.

The Republic Steel Corporation, Youngstown, Ohio, moved its New York District sales office on May 1 to the Chrysler building; **W. H. Oliver,** district sales manager, is in charge of this office. The export department, under the direction of **D. H. Bellamore,** general export manager, will also be located in the Chrysler building. The company has appointed the **Gilmore Steel & Supply Company,** San Francisco, Cal., as one of its warehouse distributors of stainless steel.

The Weyerhaeuser Pole Company, Minneapolis, Minn., has been organized to deal in the purchase, development and distribution of poles, piling and other round timber products, and will take over the pole and piling activities of the **Weyerhaeuser Sales Company. R. V. Clute,** manager of the pole and piling division of the Weyerhaeuser Sales Company, is vice-president and a director of the new company and will be in charge of the general sales office.

Personal

William F. Walsh, manager of the Railroad Sales department of the Standard Oil Company of New York, died on March 19, following a brief illness, at the New York hospital, New York City.

F. W. Sullivan has been appointed general manager of the Railroad Division of the **Socony-Vacuum Oil Company,** New York; **R. R. Vinnedge** remains as manager of eastern railroad sales, with headquarters at New York, and **C. E. Manierre,** recently appointed, heads the western organization operating out of Chicago. Mr. Sullivan was graduated from Lafayette College in 1908 and subsequently was awarded an M.A. degree by Columbia University. He started work with the Vacuum Oil Company 18 years ago and for 15 years handled the indirect markets.

C. B. Armstrong has been appointed railroad sales manager, Central division, of the **Air Reduction Sales Company,** with headquarters at Chicago, succeeding **B. N. Law,** who died on February 1. Mr. Armstrong has been associated with the Air Reduction Company since October 1, 1920, having first been employed in the sales department, at Pittsburgh, Pa. Early in 1925 he was transferred to the company's general offices at New York, and soon thereafter he was appointed general sales manager of one of the company's affiliates. He was holding this latter position at the time of his recent appointment in the sales department.

L. B. Armstrong, vice-president of the **Lundie Engineering Corporation,** Chicago, has been elected president with headquarters at New York, to succeed **Eugene Brandeis.** Mr. Armstrong was born at Lauderdale, Miss. He began his

L. B. Armstrong

railway work in 1905 with the Louisville & Nashville, serving in various capacities in the operating department, until March, 1908. In the following month he went with the Birmingham Southern, a subsidiary of the United States Steel Corporation, at Birmingham, Ala., where he served in various capacities. Mr. Armstrong joined The Lundie Engineering Corporation in April, 1920. In May, 1923, he was promoted to western manager at Chicago, and in March, 1931, was elected vice-president, which position he held until his recent promotion.

Changes in Robert W. Hunt Organization

J. C. Ogden, vice-president of the Robert W. Hunt Company, Chicago, who has been elected president, with headquarters at New York, as noted in the April issue,

J. C. Ogden

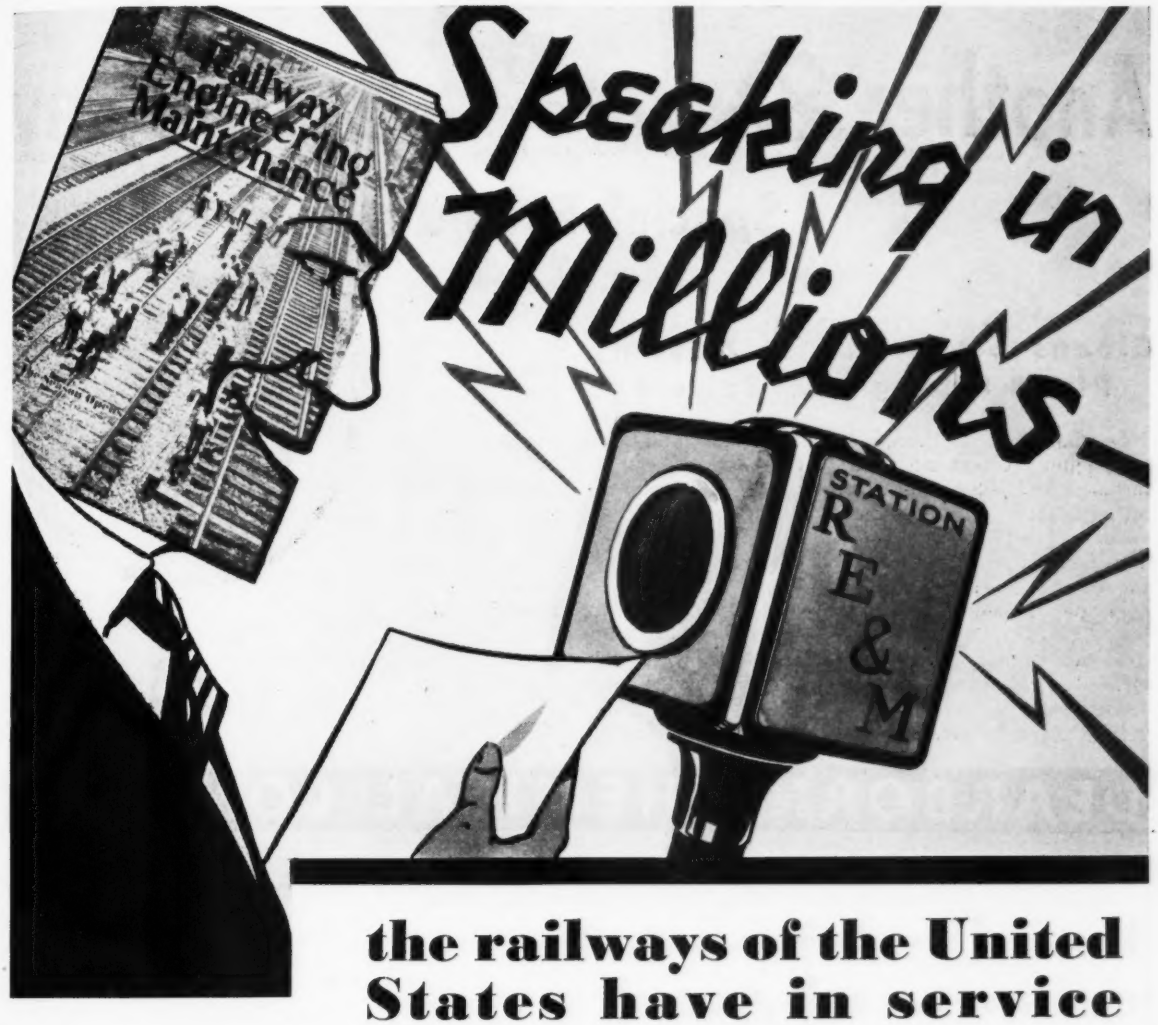
entered the employ of Robert W. Hunt & Co., in 1900, as an inspector of structual steel. He was made manager of the New York office in 1906, and when the Robert W. Hunt Company was incorporated in 1923, he was elected a director and made eastern manager. In October, 1930, he was elected vice-president.

F. M. Randlett, Pacific Coast manager for the Robert W. Hunt Company, who has been elected vice-president and general manager, with headquarters at Chicago, as noted in the April issue, graduated from Tufts College in 1897. During the next three years Mr. Randlett was employed as a teacher and in the engineering department of the New York, New Haven & Hartford. From 1900 to 1903, he was an engineer for Stone & Webster, while during the following year he occupied a similar position with the Massachusetts Electric Company at Boston, Mass. From 1905 to 1906, he was an engineer for Warren Brothers at Boston and the Warren Construction Company at Portland, Ore. In the latter year he was appointed assistant chief engineer of the water department of Portland, Ore., which position he held

F. M. Randlett

until 1917, when he was promoted to chief engineer. He held the latter position until 1925, when he entered the employ of the Robert W. Hunt Company, being located at Chicago and later at Portland. In 1926, he was appointed Pacific Coast manager at San Francisco, Cal., which position he held until his recent appointment.

M. H. Merrill, a consulting engineer at San Francisco, Cal., has been appointed western manager for the Robert W. Hunt Company, with the same headquarters, succeeding Mr. Randlett. Mr. Merrill graduated from Tufts College in 1896. He has been employed by a number of utility companies, serving two years with the Boston Elevated Company, four years with the Edison Illinois Electric Company, seven years with the Westinghouse Electric & Manufacturing Company, three years with the Allis-Chalmers Manufacturing Company and seven years as vice-president in charge of operation of a group of eastern utilities. In 1919, he became a partner in Merrill, Sweeney & Company, consulting engineers at Boston, and in 1921 acquired Mr. Sweeney's interest and specialized in utility and industrial work. In 1924, he located in San Francisco and for the past three years has acted as consultant for the Robert W. Hunt Company.



the railways of the United States have in service

54 ***million*** **tons of rails**
1,200 ***million*** **crossties**
1,000 ***million*** **tie plates**
145 ***million*** **rail joints**
19 ***million*** **tons of structural steel**
8 ***million*** **squares of roofing**
165 ***million*** **lineal ft. of pipe,**
etc.

Maintenance Mike says: "I don't know much about figures, but the railways use a powerful lot of materials—It must keep a lot of factories busy making them."

These figures are indicative of the vast quantities of materials entering into the railway plant of this country.
It is valued at 26,000 *million* dollars.
And it requires 450 million man hours, and 200 million dollars worth of materials every year—even in these days—to keep it up.

(If the railways of Canada are included, these figures are increased 10 per cent)
Railway Engineering and Maintenance is the "station" through which manufacturers of track, bridge and building and water service materials and equipment broadcast their messages to the railway market.

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

Another Dearborn Economy

TRADE MARK REGISTERED

Special Formula No. 134

Cleans Scale Out of Heating Plant Piping and Boilers

Dearborn Special Formula No. 34 removes all scale thoroughly, economically and quickly, regardless of thickness and without injury to the metal. Now is the time as plants are going out of service to put heating systems of buildings and stations in good condition for next fall. Removal of scale will effect savings in fuel and will aid in efficient plant operation.

Heating systems should be cleaned with Dearborn Special Formula No. 134 every second or third year. Also this formula is in wide use for periodic cleaning of feed lines, meters, coils, pumps, engine jackets and condensers.

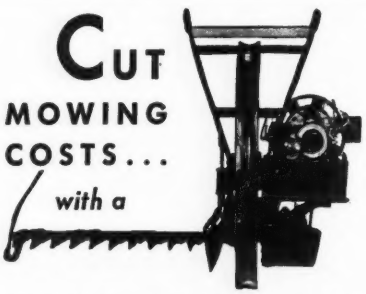
It is strongly recommended for periodical removal of scale from closed type feed water heaters.

This easily handled product has been on the market for years and is well and favorably known in railway use. Serviced by experienced Dearborn Representatives. Consultation invited.

Address us 310 South Michigan Avenue, Chicago; 205 East 42nd Street, New York; 2454 Dundas Street, West, Toronto.

DEARBORN CHEMICAL COMPANY

CUT MOWING COSTS... with a



DETROIT MOTOR SCYTHE

- Here is the most economical and easily handled cutter on the market.
- It goes anywhere, cuts anything, and enables one man to do the work of four or more with hand scythes—eliminating costly hand mowing around fences, poles, signs, buildings, bridges, and along right-of-ways which are beyond the reach of track mowing and weeding machines.
- It has a 36-inch sickle driven by a powerful one-cylinder gasoline motor and is mounted on a free running 30-inch wheel, allowing it to be backed up, pivoted sharply, or tilted up or down slopes similar to a wheelbarrow.
- It is now produced by a recognized leader among mower manufacturers and during over four years of service, thousands of users have enthusiastically testified to its dependability.

Write for prices and Bulletin No. 9

DETROIT HARVESTER CO.
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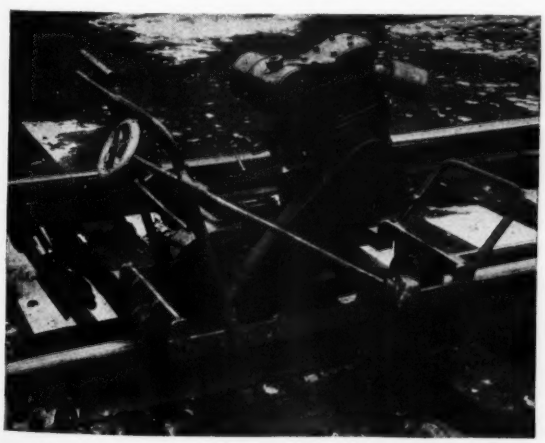
SWITCH POINTS AND STOCK RAILS

Good As New!

HERE'S a grinder made to take off the overflowed metal from switch points and stock rails. A few minutes grinding on the stock-rail with this grinder, with the wheel set in right position, will not only remove all overflow metal, but will also provide a semi housing effect for the switchpoint, resulting in a much safer and better operating condition as well as the most ideal fitting of the points against the stock rail. Gasoline or electric motor powered.

Operating 10" diam. double grinding wheel. Swivel Feature easily adjusts grinder head to follow rail or switch point. A well made, substantial outfit.



Railway Trackwork Co.

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OR ON THE RIGHT OF WAY AT FROM 3 to 5 DOLLARS PER MILE

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Keep a drum on hand for spotty or for continuous treatment in heavily infested areas.

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For Railroad Construction, Maintenance and Repair

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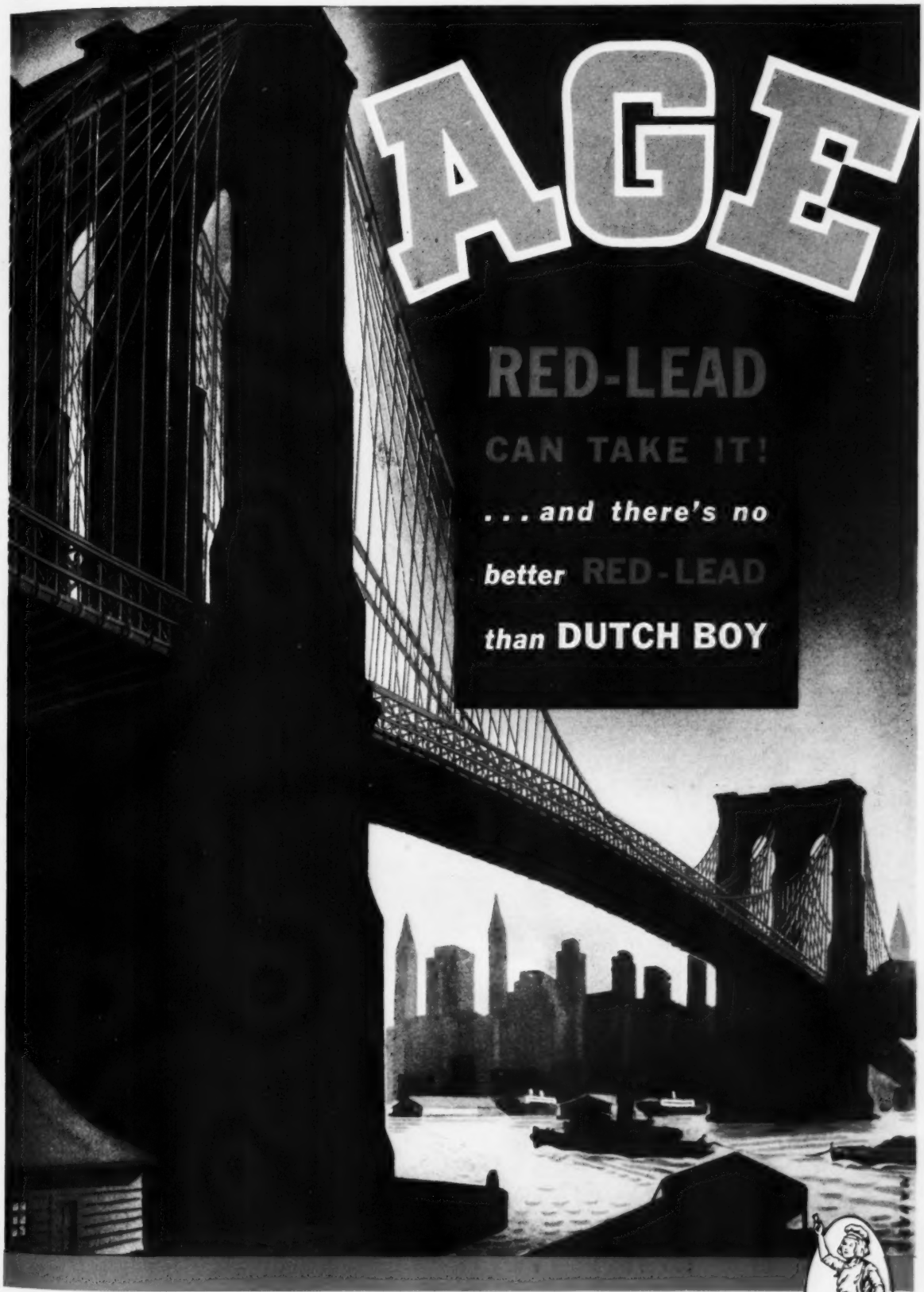

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